

AN EXAMINATION OF WHY SASKATCHEWAN WOMEN CHOOSE
MASTECTOMY VERSUS BREAST CONSERVATION THERAPY IN EARLY STAGE
BREAST CANCER

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In Partial Fulfilment of the Requirements
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By

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Abstract

Introduction and Research Purpose

Breast cancer is the most commonly diagnosed cancer in North America and the second most common cause of cancer death in women. For early stage breast cancer (ESBC), it is well established that breast conservation therapy (BCT) and mastectomy are equivalent treatments for survival. Treatment for ESBC can therefore be viewed as preference sensitive care, where decision-making between treatment options should vary according to patient preferences. In Canada, interprovincial mastectomy rates vary greatly from 25% to 68% between provinces with a national average of 38%. Saskatchewan has consistently reported the nation's second highest mastectomy rate with the latest report showing 63%. There has been international research investigating why women choose mastectomy versus BCT, but there is limited data within Canada to explain these provincial variations. The aim of my thesis is to better understand Saskatchewan women's choice between mastectomy and BCT in ESBC. In this dissertation, I have addressed the research objectives through four manuscripts outlined below

Manuscript 1:

To assess the current evidence, we conducted the first systematic review on the factors influencing women's choice of mastectomy versus BCT in ESBC.

Manuscript 2:

To identify the factors that influence Saskatchewan women's choice between BCT or mastectomy in ESBC, we conducted a province-based qualitative study which identified themes and subthemes influencing therapy choice. This was the first part of an exploratory mixed methods study.

Manuscript 3:

To help improve our understanding and organize our research, we created a conceptual framework of why women choose mastectomy versus BCT in ESBC. This framework was important in organizing our systematic review and guiding our survey.

Manuscript 4:

Finally, to understand decision-making influences of Saskatchewan women with ESBC, we conducted a province wide survey. Creation of this survey was grounded on our previous work and the second portion of our mixed methods study.

Results and Conclusion

Our research demonstrates treatment choices for Saskatchewan women with ESBC were primarily influenced by disease stage and individual belief factors. These findings would suggest that women are making their treatment choices predominantly based on individual values and preferences. The use of mastectomy and BCT rates as an indicator of quality of care may be misleading. Instead, a shift in attention towards patient-centred care is more appropriate.

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Dedication

I would like to dedicate this thesis to all women faced with the challenging diagnoses of breast cancer, their supports such as family and friends, and the health care team involved in their care. The Saskatchewan women who have dedicated their time in partaking in this thesis work deserve particular acknowledgement.

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List of Abbreviations

BCS = Breast Conserving Surgery

BCT = Breast Conserving Therapy

Beh-REB = Behavioural Research Ethics Board

CIHI = Canadian Institute for Health Information

CPAC = Canadian Partnership Against Cancer

CS and RT = Conservative Surgery and Radiation

DCIS = Ductal Carcinoma in Situ

DCS = Decisional Conflict Scale

EORTC = European Organization for Research and Treatment of Cancer

ESBC = Early Stage Breast Cancer

ID = Interpretive Description

IP-SDM = Interprofessional Shared Decision-making

JBI = Joanna Briggs Institute

OR = Odds Ratio

PBC = Perceived Behavioral Control

PICO = Population, Intervention, Comparison, Outcome

PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses

NIH = National Institute of Health

NCCN = National Comprehensive Cancer Network

NCI = National Cancer Institute

NOS = New-Castle Ottawa Scale

NSABP = National Surgical Adjuvant Breast and Bowel Project

SCA = Saskatchewan Cancer Agency

SDM = Shared Decision-Making

SES = Socioeconomic Status

SSRL = Social Science Research Lab

TPB = Theory of Planned Behavior

TRA = Theory of Reasoned Action

U of S = University of Saskatchewan

Authorship Declaration

This thesis contains work that has been published or prepared for publication. All studies in this dissertation were conceptualized and executed by the candidate (Jeffrey Gu) in collaboration with his thesis supervisors: Dr. Gary Groot and Dr. Rachel Engler-Stringer. All studies were approved by the thesis advisory committee. Additional collaborators to the manuscripts include Dr. Lorraine Holtslander, Dr. June Lim, Dr. Catherine Boden, Dr. Angela Busch, and Dr. Megan Delisle. Jeffrey Gu takes full responsibility for the accuracy of this thesis. All authors of the manuscripts included in the thesis provided intellectual input on the study design, participated in the interpretation of the results, and assisted with preparation of the manuscript drafts. All authors approved final manuscripts.

Three manuscripts generated from this thesis have been published:

Chapter 3, Manuscript #1: Gu J, Groot G, Boden C, Busch A, Holtslander L, Lim H. Review of Factors Influencing Women's Choice of Mastectomy Versus Breast Conserving Therapy in Early Stage Breast Cancer: A Systematic Review. Clin Breast Cancer. 2018 Aug;18(4):e539–54.

DOI: 10.1016/j.clbc.2017.12.013

Chapter 5, Manuscript #2: Gu J, Groot G, Holtslander L, Engler-Stringer R. Understanding Women's Choice of Mastectomy Versus Breast Conserving Therapy in Early-Stage Breast Cancer. Clin Med Insights Oncol. 2017;11:1179554917691266.

DOI: 10.1177/1179554917691266

Chapter 6, Manuscript #3: Gu J, Groot G. Creation of a new clinical framework – why women choose mastectomy versus breast conserving therapy. BMC Medical Research Methodology. 2018 Jul 9;18(1):77.

DOI: 10.1186/s12874-018-0533-7

One manuscript from this thesis has been submitted for publication:

Chapter 8, Manuscript #4: Mastectomy versus breast conservation therapy: an examination of how individual, clinicopathological, and physician factors influence decision making.

Authors: Jeffrey Gu, Megan Delisle, Rachel Engler-Stringer, and Gary Groot.

CHAPTER 1: INTRODUCTION

1.1 Research Problem

In North America, breast cancer is the most commonly diagnosed cancer as well as the second most common cause of cancer death in women.(1) For early stage breast cancer (ESBC), it is well established that breast conservation therapy (BCT) and mastectomy offer equivalent rates of survival.(2–9) However, since the seminal National Institute of Health (NIH) Consensus Conference in 1991, the surgical literature has consistently recommended BCT as preferable to mastectomy.(10) A recent Canadian Partnership Against Cancer (CPAC) system performance report lays down similar guidelines: “BCT is therefore generally recommended for most women with Stage I or II breast cancer.”(11) In Saskatchewan, however, from 2007 to 2010, 65% of newly diagnosed breast cancer patients underwent mastectomy – the second highest mastectomy rate in Canada.(12) The choice of mastectomy versus BCT is a complicated decision-making process influenced by many factors.(13) The literature focused on identification of these factors with a view to treating ESBC exhibits heterogenous study design and offers only limited experimental or prospective evidence.(13–18) Accordingly, it is unknown whether the factors highlighted in the literature are generalizable to the Saskatchewan population. The aim of this thesis is to better understand Saskatchewan women’s choice between mastectomy versus BCT in ESBC, improving understandings of this complicated decision-making process and supplying physicians and administrators with a basis for future policy review and quality improvement opportunities when providing patient care.

1.2 Objectives

The objectives of this research are as follows:

1. To assess the evidence related to women's choice between BCT and mastectomy through a systematic review.
2. To identify factors that influence Saskatchewan women's choice between BCT and mastectomy in cases of ESBC.
3. To compare and contrast underlying reasons behind the choice between mastectomy and BCT in cases of ESBC.
4. To quantitatively examine the significance and weight of factors influencing Saskatchewan women's choice between BCT and mastectomy in cases of ESBC.
5. To understand the appropriateness of Saskatchewan's surgical variation in mastectomy rates relative to the rest of Canada.

1.3 Dissertation Organization

This dissertation is a manuscript-based thesis structured around four manuscripts with accompanying introduction, background, transition, and conclusion chapters. The manuscripts include a systematic review, the creation of a framework, and a sequential mixed-methods study. No other systematic reviews have been published on this topic, so such an approach is important for synthesis of the literature and to inform our survey development. In the interest of time efficiency, we began our mixed methods study concurrent with the later stages of the systematic review. The mixed methods study began with an exploratory qualitative study, in which we identified influencing factors in decision-making and their relationships with the choice between mastectomy and BCT in cases of

ESBC. As the initial research from the qualitative study and the review evolved alongside each other, the complexity of women's reason for choosing mastectomy over BCT became clear, revealing the need for a guiding structure to help frame this work. During this time, I developed a conceptual framework to examine why women choose mastectomy versus BCT in cases of ESBC. This framework, in turn, helped guide the organization and analysis of both the systematic review and the subsequent survey. As a by-product of this interconnected process, the framework manuscript, after having been initially introduced in the systematic review, in chapter 2, is not is presented until chapter 6. The final component of this dissertation, representing the second phase of our mixed methods study, is a province-wide survey capturing a much larger sample of the population. Creation of this survey was grounded in the work of the systematic review, the initial qualitative research, and the conceptual framework.

CHAPTER 2: BACKGROUND LITERATURE

2.1 Early Stage Breast Cancer Equivalent Survival

In 1991, the NIH Consensus Conference published recommendations on the Treatment of Early-Stage Breast Cancer.(10) The conference, which took place June 18 to June 21, 1990, brought together representatives of the American College of Surgeons, the American College of Radiology, the College of American Pathologists, the American Cancer Society, and the Society of Surgical Oncology. This was the first consensus panel to recommend breast conservation treatment as equivalent therapy to mastectomy for women who have ESBC. In fact, BCT was recommended as the 'preferable' primary therapy in the report: 'Breast conservation treatment is an appropriate method of primary therapy for the majority of women with stage I and II breast cancer and is preferable because it provides survival rates equivalent to those of total mastectomy and axillary dissection while preserving the breast'.(10)

The report defined breast conservation treatment as 'excision of the primary tumor and adjacent breast tissue (also known as lumpectomy, segmental mastectomy, or partial mastectomy), followed by radiation therapy'. The report continued to state total mastectomy is an appropriate primary therapy when BCT is not indicated or selected. Both surgical therapies are accompanied by axillary dissection, which provides important prognostic information. These recommendations, and the distribution of the landmark studies, have radically changed breast cancer practice and generally align with the current Canadian consensus statement and National Comprehensive Cancer Network (NCCN) practice guidelines.(19,20)

Six prospective randomized control trials that have examined mastectomy versus breast conservation therapy and radiation for early stage breast cancer. Whole breast irradiation was used in each of the trials and varied from 45 to 50 Gy.(4-8,21,22) Five of the six trials also employed a boost to the primary cancer site, whereas the National Surgical Adjuvant Breast and Bowel Project (NSABP) B-06 trial delivered a dose of 50 Gy to the entire breast without a primary site boost. No significant differences in survival rates were seen between the two treatments in any of the trials. This survival equivalence has been further confirmed in a meta-analysis of the prospective randomized trials.(9) In an update of guidelines for 'Standard for Breast Conservation Therapy in the Management of Invasive Breast Carcinoma', Morrow summarized the results of these trials, as shown in Tables 2.1 and 2.2.(3)

Table 2.1: Prospective randomized trials comparing conservative surgery and radiation with mastectomy for early-stage breast cancer

Trial	Treatment Period	Total Number of Patients	Stage	Surgery for Primary	Adjuvant Therapy
Milan I	1973-1980	701	I	Q, RM	CMF
Institut Gustave-Roussy	1972-1980	179	I	WE MRM	None
NSABP B-06	1976-1984	1,219	I-II	WE MRM	Melphalan 5 FU
National Cancer Institute	1979-1987	237	I-II	WE MRM	AC
EORTC	1980-1986	868	I-II	LE, MRM	CMF
Danish Breast Cancer Group	1983-1989	904	I-III	Q, WE MRM	CMF Tamoxifen
5FU = 5-fluorouracil. AC = Doxorubicin, Cyclophosphamide. CMF = Cyclophosphamide, Methotrexate, 5-fluorouracil. EORTC = European Organization for Research and Treatment of Cancer. LE = Local Excision. MRM = Modified radical mastectomy. Q = Quadrantectomy RM = Radical Mastectomy WE = Wide Excision					

Morrow M, Strom EA, Bassett LW, Dershaw DD, Fowble B, Giuliano A, et al. Standard for breast conservation therapy in the management of invasive breast carcinoma. CA Cancer J Clin. 2002 Oct;52(5):277-300

Table 2.2: Survival comparison for conservative surgery and radiation (CS and RT) versus mastectomy in prospective randomized trials

Trial	Endpoint	Overall Survival % CS and RT/Mastectomy	Disease-free Survival % CS and RT/Mastectomy
Milan I	18 years	65 (NS) 65	
Institut Gustave-Roussy	15 years	73 (0.19) 65	
NSABP B-06	12 years	63 (0.12) 59	50 (0.21) 49
National Cancer Institute	10 years	77 (0.89) 75	72 (0.93) 69
EORTC	10 years	65 (NS) 66	
Danish Breast Cancer Group	6 years	79 (NS) 82	70 (NS) 66
() = p-value EORTC = European Organization for Research and Treatment of Cancer NS = Not Significant			

Morrow M, Strom EA, Bassett LW, Dershaw DD, Fowble B, Giuliano A, et al. Standard for breast conservation therapy in the management of invasive breast carcinoma. CA Cancer J Clin. 2002 Oct;52(5):277-300

However, some uncertainty remains in the literature about whether there is increased local recurrence risk in the treated breast or chest wall with BCT compared to mastectomy. This uncertainty arises chiefly from heterogeneity in the study populations and from inconsistency in the studies' definitions of local recurrence. Depending on the publication, local recurrence has included nodal recurrence, skin recurrence, all recurrences in the ipsilateral breast, or selective ipsilateral breast recurrences. Table 2.3 summarizes the data from the prospective randomized trials. Overall, the incidence of local recurrence ranges from 3% - 20% in the BCT group compared with 4% - 14% in the mastectomy group and four of the six randomized trials showed no significant difference in local recurrence. A significantly higher local failure rate observed in the National Cancer Institute (NCI) trial, but only gross tumor removal was required for study entry, as they did not mandate microscopically negative margins – microscopically positive margins being strongly associated with increased risk of local recurrence.(23,24) Similarly, in the European Organization for Research and Treatment of Cancer (EORTC) trial, 48% of the

patients had microscopically positive resection margins and 81% of the patients in the BCT arm had T2 tumors – a relatively high percentage.

Table 2.3: Comparisons of local recurrence following conservative surgery and radiation (CS and RT) or mastectomy in prospective randomized trials

Trial	Endpoint	CS and RT	Mastectomy
Milan I	Cumulative incidence at 18 years	7% (NS)	4%
Institut Gustave-Roussy	Cumulative incidence at 15 years	9% (NS)	14%
NSABP B-06	Cumulative Incidence	10%	8%
National Cancer Institute	Crude incidence median follow-up at 10.1 years	19% (0.01)	6%
EORTC	Actuarial at 10 years	20% (0.01)	12%
Danish Breast Cancer Group	Crude Incidence median follow-up at 3.3 years	3% (NS)	4%
() = p-value EORTC = European Organization for Research and Treatment of Cancer NS = Not Significant			

Morrow M, Strom EA, Bassett LW, Dershaw DD, Fowble B, Giuliano A, et al. Standard for breast conservation therapy in the management of invasive breast carcinoma. CA Cancer J Clin. 2002 Oct;52(5):277–300

2.2 Mastectomy Rates in Canada

2.2.1 Breast Cancer Surgery in Canada, 2007-2008 to 2009-2010

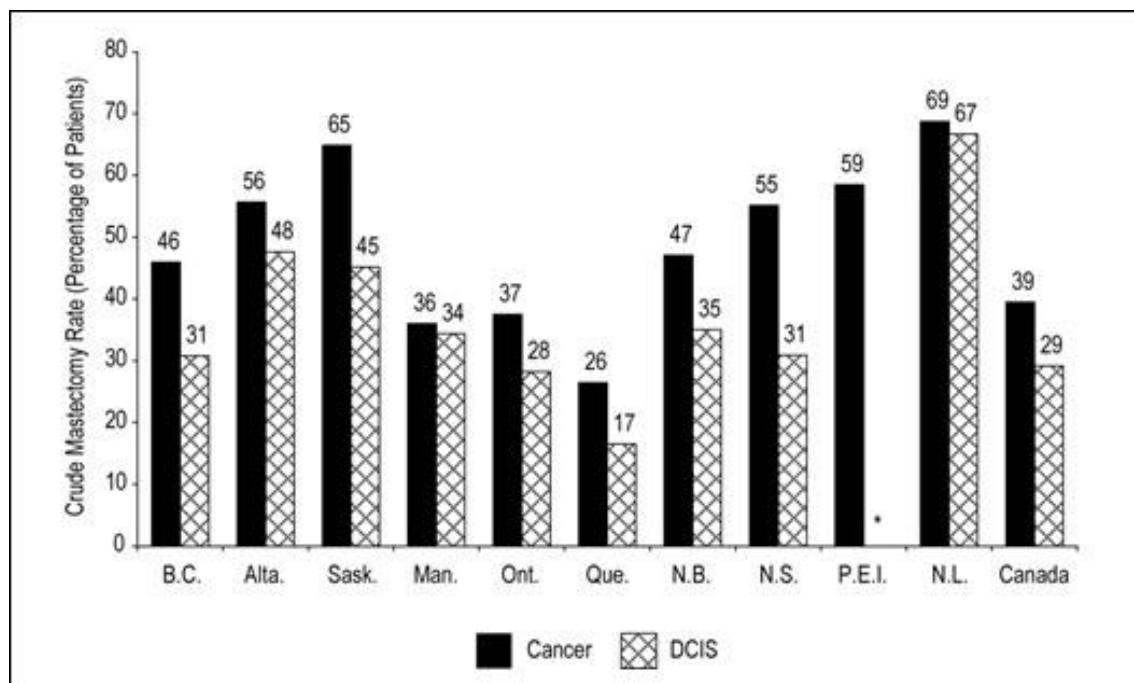
In 2012, an estimated 22,700 Canadian women were diagnosed with invasive breast cancer, 5,100 of whom died of the disease.(1) In October of 2012, the Canadian Institute for Health Information (CIHI) and the Canadian Partnership Against Cancer (CPAC) published a report from a pan-Canadian perspective on patterns in surgical care named ‘Breast Cancer Surgery in Canada, 2007-2008 to 2009-2010’.(12) It was the first report of such scope and magnitude to examine invasive breast cancer in Canada. This report is important to understanding measures of quality of care while examining variations in clinical practice. The key findings from this report are outlined hereafter.

The study cohort covered a three-year period from 2007-2008 to 2009-2010. During this time 65,067 women, or roughly 22,000 per year, were treated surgically for

breast cancer. The majority of these women (57,840; 89%) were treated for invasive disease, and almost all were treated for unilateral disease (56,892; 98%). A relatively small portion of the cohort was treated for ductal carcinoma in situ (DCIS) (7,227; 11%). A small fraction of those originally treated for DCIS were subsequently treated surgically for a diagnosis of invasive breast cancer within one year (548; 8%).(12)

Significant variation in mastectomy rates were seen among this group of women across the country. The crude mastectomy rate for invasive breast cancer nationally was 39%, but the figure varied by province, from 26% in Quebec to 69% in Newfoundland and Labrador. Saskatchewan had the second highest reported rate of mastectomy in Canada, with a crude rate of 65% (1,094 of 1,686). Figure 2.1 below shows the rates of mastectomy among women who had unilateral invasive breast cancer and DCIS. Because the graph is sourced from the Breast Cancer Surgery in Canada report, it includes figures for DCIS.(12)

Figure 2.1: Crude mastectomy rates among women with unilateral invasive breast cancer versus DCIS only, whose first surgery took place between 2007-2008 and 2009-2010

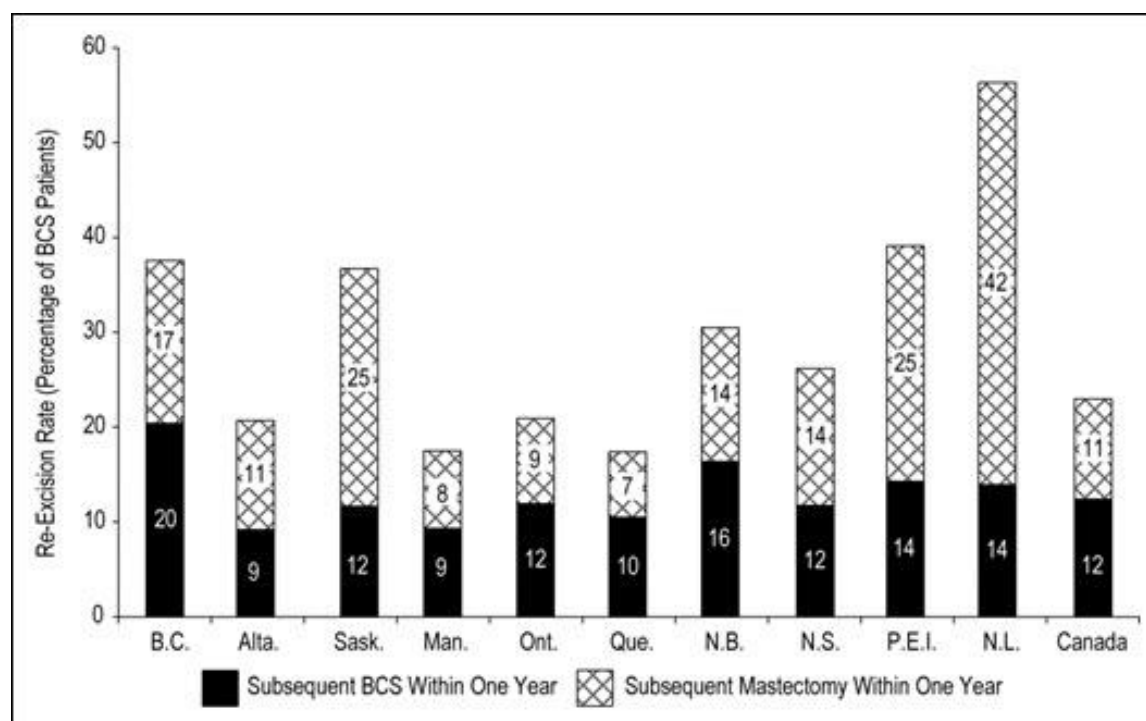


Three data sources were used to identify all inpatient and outpatient surgical procedures that took place between 2006-2007 and 2010-2011: the Hospital Morbidity Database, CIHI; the National Ambulatory Care Reporting System, CIHI; and the Alberta Ambulatory Care Reporting System, Alberta Health and Wellness. A woman's first known index surgical procedure for breast cancer was based on the first discharge meeting the inclusion/exclusion criteria, with no recorded history of breast cancer. Appendix A gives the full patient selection criteria. Data from 2006-2007 were included to all exclusion of patients who had a record of surgical treatment of breast cancer within the past year. From the index surgery, a treatment window of one year was established. All surgical interventions during this one-year period were identified. The surgical procedures were coded hierarchically, so that if a woman underwent breast conserving surgery (BCS) for primary breast cancer in the left breast and within 365 days had the breast surgically removed, she was coded for analytical purposes as having had a mastectomy.

Re-excision rates after BCS also demonstrated significant provincial variation. (12) Re-excision is usually indicated if positive margins are present in the initial resection.(25) The subsequent re-excision procedure may be further BCS with a wider excision or conversion to mastectomy. The relatively high rates of re-excision in some provinces may explain and influence geographical variation in provincial mastectomy rates. If a patient who initially underwent BCS had subsequent mastectomy at any point during the next year, she would be coded as undergoing mastectomy in their final procedure. Eleven percent of women who had unilateral invasive breast cancer and who initially had BCS subsequently underwent mastectomy within a year of their initial procedure, increasing the national rate

of mastectomy from an initial figure of 32% to 39% within a year of the initial diagnosis. In Saskatchewan, the mastectomy rate rose from 53% initially to 65% as the final procedure, for a 12% conversion to mastectomy – which is higher than the national average. The rates of re-excision for women who underwent BCS as their index procedure, as well as the index and final mastectomy rates across the country for unilateral invasive breast cancer are displayed in the Figure 2.2 and Table 2.4. (12)

Figure 2.2: Rates of re-excision among women who underwent BCS for invasive breast cancer as their index procedure, by province, 2007-2008 to 2009-2010



Canadian Institute for Health Information. Breast Cancer Surgery in Canada 2007-2008 to 2009-2010 [Internet]. Canadian Institute for Health Information; 2012 Oct. Available from: <https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC1936>

Table 2.4: Mastectomy and BCS among women with unilateral invasive breast cancer, index versus final procedure

Index Procedure											
	B.C.	Atla.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
BCS	4,877	2,490	790	1,396	14,738	11,792	837	928	133	481	38,517
Mastectomy	2,596	2,482	896	607	6,719	3,138	521	843	107	406	18,375
Total	7,473	4,972	1,686	2,003	21,457	14,930	1,358	1,771	240	887	56,892
Final Procedure											
	B.C.	Atla.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
BCS	4,040	2,204	592	1,282	13,413	10,979	719	794	100	277	34,439

Mastectomy	3,433	2,767	1,094	721	8,045	3,951	639	977	141	609	22,453
Total	7,473	4,971	1,686	2,003	21,458	14,930	1,358	1,771	241	868	56,892
Note Small differences between the totals for the index and final procedures for selected provinces are due to women moving to another province during the treatment period.											

Data for a few other important factors expected to influence mastectomy rates – age group, neighbourhood income quintile, and travel time to the closest cancer centre – were included in the logistic regression model to provide adjusted mastectomy rates. Consistent with some U.S. population-based studies, mastectomy rates were higher among women of younger age (<50) and those of older age (70+).(13,26) Women living in the least affluent neighbourhoods by quintile were more likely to undergo mastectomy than women living in the most affluent neighbourhoods. Moreover, mastectomy rates significantly elevated with increases in travel time to the nearest cancer centre having a radiation facility. More specific data regarding these factors can be found in the report. Even when incorporating these factors, the discrepancies in provincial mastectomy rates were only marginally reduced in the adjusted rate, for a 26-percentage point absolute difference remaining between the highest and lowest mastectomy rates (35% to 61%). Saskatchewan remained the second highest, with an adjusted mastectomy rate of 60% and the Canadian mastectomy rate changed from 39% to 44%.(12) Table 2.5 shows the crude and adjusted mastectomy rates by province.

Table 2.5: Crude and adjusted mastectomy rates among women with unilateral invasive breast cancer, by province, 2007-2008 to 2009-2010

	Crude Rate	Adjusted Rate	Canada
B.C.	46%	45%	44%
Alta.	56%	56%	44%
Sask.	65%	60%	44%
Man.	36%	35%	44%
Ont.	38%	39%	44%
N.B.	47%	41%	44%
N.S.	56%	52%	44%

P.E.I.	59%	56%	44%
N.L.	69%	61%	44%
Notes Data relates to patients who received their index procedure between 2007-2008 and 2009-2010. Excludes data for residents of the three territories and Quebec. Adjusted rates control for age group, neighbourhood income quintile and travel time to closest cancer centre. Crude rates in this table differ from those presented in Figure 1 due to calculations of denominators for each province included in the analysis			

Canadian Institute for Health Information. Breast Cancer Surgery in Canada 2007-2008 to 2009-2010 [Internet]. Canadian Institute for Health Information; 2012 Oct. Available from: <https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC1936>

Reports presenting data collection and analysis at a national level are subject to many limitations and cautions when interpreting results. Chief among these is unavailability or omission of data on stage of disease, which is a crucial determinant of treatment. Although most invasive breast cancers do present with early stage,(11) use of mastectomy rates adjusted for stage of disease or stratification of the data by stage could significantly affect provincial variations in mastectomy rates. Additionally, procedural codes could not be used to distinguish between BCS and open excisional biopsy. If open excisional biopsy was the final procedure that women received to remove all their invasive breast cancer, they likely would have had no opportunity to decide between BCS and mastectomy, having not been diagnosed prior to that procedure. Although use of open excisional biopsy is low compared to needle biopsy, the inclusion such cases could result in underestimation of index and final mastectomy rates.

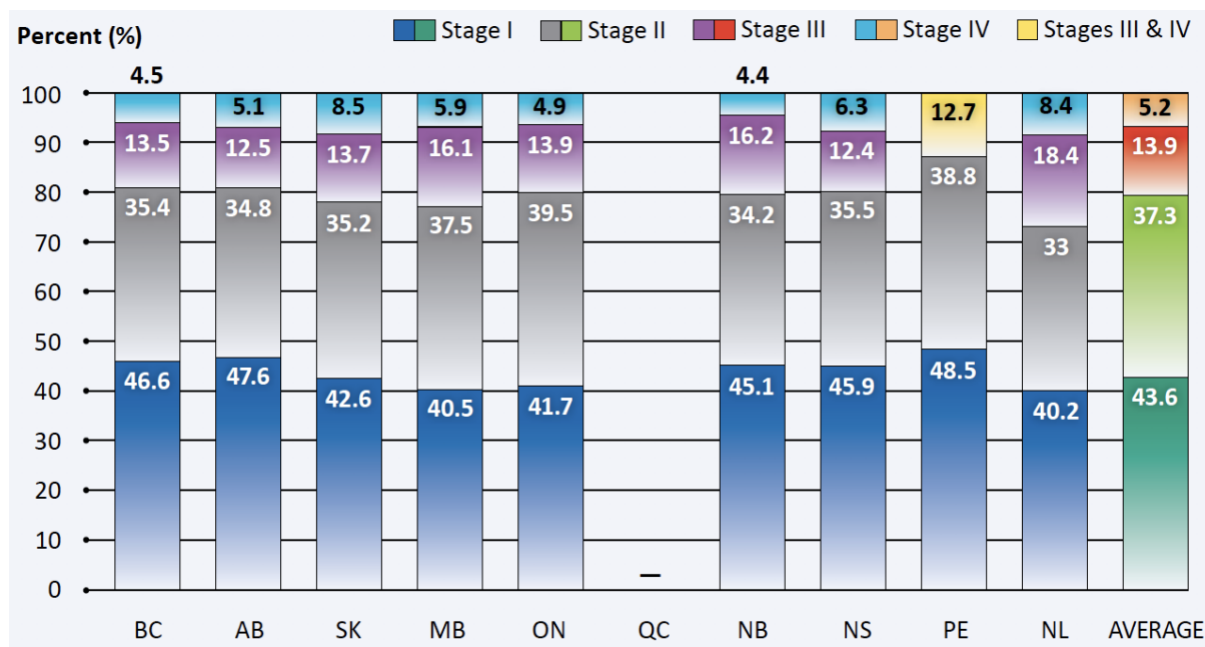
The variation-related findings highlighted in this report raise questions about how Canadian women are exercising their treatment options and about the related quality of surgical care. Breast Cancer Surgery in Canada reports that “[e]xamination of clinical practices by province/territory will be needed to better understand these variations.”(12) Further investigation using more rigorous study designs is needed to improve understandings of variations in treatment and their relation to quality of care. As the limitations in this report could be significant, future studies should adjust for them when

seeking to confirm this reports findings. From there, opportunities for research and quality improvement broaden. As suggested by CIHI and CPAC, areas in need of research include: examination of local practice patterns, examination of patient factors affecting decision-making, internal audits of practices, and education in quality improvement.

2.2.2 Distribution by Stage of Disease

Data on distribution by stage of disease were not provided in the Breast Cancer Surgery in Canada but were presented in a separate CPAC report, 'Breast Cancer Control in Canada'.⁽¹¹⁾ This report presented a stage-based distribution of diagnosis in Canada, by province, for 2010. Although data presented covered just one year, they indicated general distribution by stage of disease. In Canada, more than 80% of invasive breast cancer cases were diagnosed with early stage disease (stage 1 or 2). Figure 2.3 shows interprovincial variations in breast cancer stage distribution, including most notably with Newfoundland's higher percentage of advanced disease diagnosis.⁽¹¹⁾

Figure 2.3: Distribution by stage at diagnosis of women diagnosed with invasive breast cancer in Canada in 2010, by province



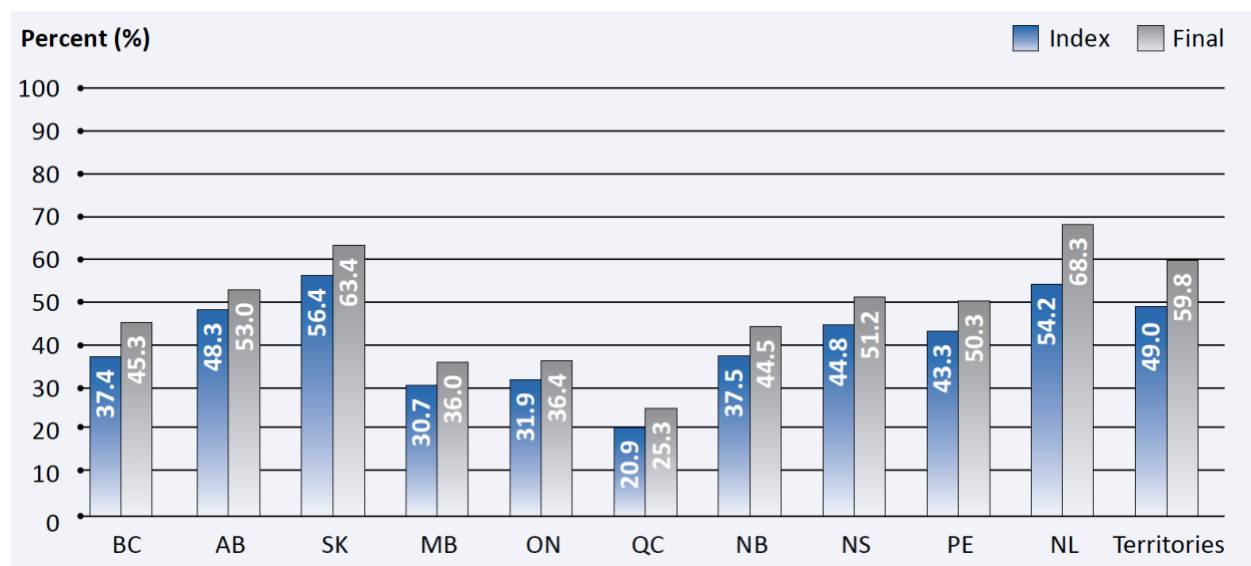
Canadian Partnership Against Cancer. Breast Cancer Control in Canada: A System Performance Special Focus Report [Internet]. Canadian Partnership Against Cancer; 2012. Available from: http://www.cancerview.ca/idc/groups/public/documents/webcontent/breast_cancer_control_rep.pdf

2.2.3 The 2015 Cancer System Performance Report

In 2015, the CPAC published updated data on cancer system performance indicators including a Canadian breast cancer update.(27) This report covered women who had unilateral invasive breast cancer who underwent surgery between April 2008 and March 2013. Data were obtained from hospital abstract databases maintained by CIHI. Data reporting was similar to the previous 'Breast Surgery Cancer in Canada' report.(12) Because data were not linked to provincial cancer registries, they might include some women who had recurrent disease, although selection criteria were employed to minimize inclusion. Because open excisional biopsies and BCS still did not have differentiating procedural codes, provinces utilizing more open biopsies could have higher rates of BCS first followed by mastectomy. Results were presented by index procedure rates(the patients' first procedure) and final procedure rates, with the mastectomy rate including women who initially had BCS but subsequently underwent mastectomy within a year.(27)

Figure 2.4 presents mastectomy rates by province. Index mastectomy rates ranged from 20.9% in Quebec to 56.4% in Saskatchewan. Final mastectomy rates ranged from 25.3% in Quebec to 68.3% in Newfoundland and Labrador.(27) Canada as a whole had an index mastectomy rate of 32.8% and a final rate of 38.1%.(28) Figure 2.1, which compares updated final mastectomy rates of provinces with previously reported crude mastectomy rates (crude and final mastectomy rates are synonymous), shows little notable difference for the majority of provinces. For Saskatchewan, the final mastectomy rate for invasive cancer changed from 65% to 63.4% between reports.(12,27)

Figure 2.4: Percentage of breast cancer resections that are mastectomies, by province/territory – from 2008/2009 to 2012/2013 fiscal years combined



Canadian Partnership Against Cancer. The 2015 Cancer System Performance Report [Internet]. Canadian Partnership Against Cancer; 2015. Available from: systemperformance.ca

2.3 Surgical Variation

Regional variations in surgery are not unique to treatment of ESBC but are in fact a well-documented phenomenon throughout medical practice for many surgical procedures. James Glover published a seminal article in 1938 that described a twenty-fold difference in tonsillectomy rates between the highest- and lowest-rated school districts, which were

separated by just seven miles.(29) Variation in that particular procedure was due to the referring medical officer. A recent Lancet publication reviewed surgical variation and concluded that the relative variation in population-based rates of many common procedures has remained largely stable over the past twenty years despite major advances in clinical sciences in the past few decades – highlighting the need for continued work in this field.(30)

Variation in surgical provision often raise questions about whether proper care is being provided. Are surgical procedures being overused in the relatively high-utilization areas, or are they being underused in the relatively low-utilization areas – or some combination of both? Are the surgical practices in line with the best clinical practice guidelines, or do other reasons underlie inconsistencies? Are surgeons' or surgical groups' attitudes and beliefs regarding certain procedures that are influencing surgical rates? Are patient preferences based on societal and cultural differences that are influencing these differences? Are variations the result of more upstream factors such as diagnostic patterns or referral patterns? High rates of surgical procedures are often attributed to inappropriate use but findings from a recent systematic review concluded there was little evidence to support or refute this conclusion, as there were only five studies identified in that past thirty years that have examined this relationship.(31)

Surgical variations between procedures cannot all be viewed the same. Wenneberg et al grouped practice variations into three categories: effective care, preference sensitive care, and supply sensitive care.(32) Effective care includes treatments for which good evidence supports one intervention, with no good alternative options available. Examples included colectomy for colon cancer or repair of a hip fracture. Variations in this category

generally suggest inappropriate underutilization in lower-use areas. Preference sensitive care includes interventions for problems that have more than one acceptable treatment option. Examples include radical prostatectomy, radiotherapy, or active surveillance for prostate cancers and BCT or mastectomy for ESBC. Ideally, differences reflect patient preferences and values, but they could vary for other reasons as well. Supply sensitive care includes services limited by the availability of resources. Examples are availability of physician visits, hospital beds or specialist consultations. Most surgical interventions do not fall under this category. Preference sensitive care represents the largest of the categories for surgery, which includes decision-making between mastectomy and BCT in cases of ESBC.

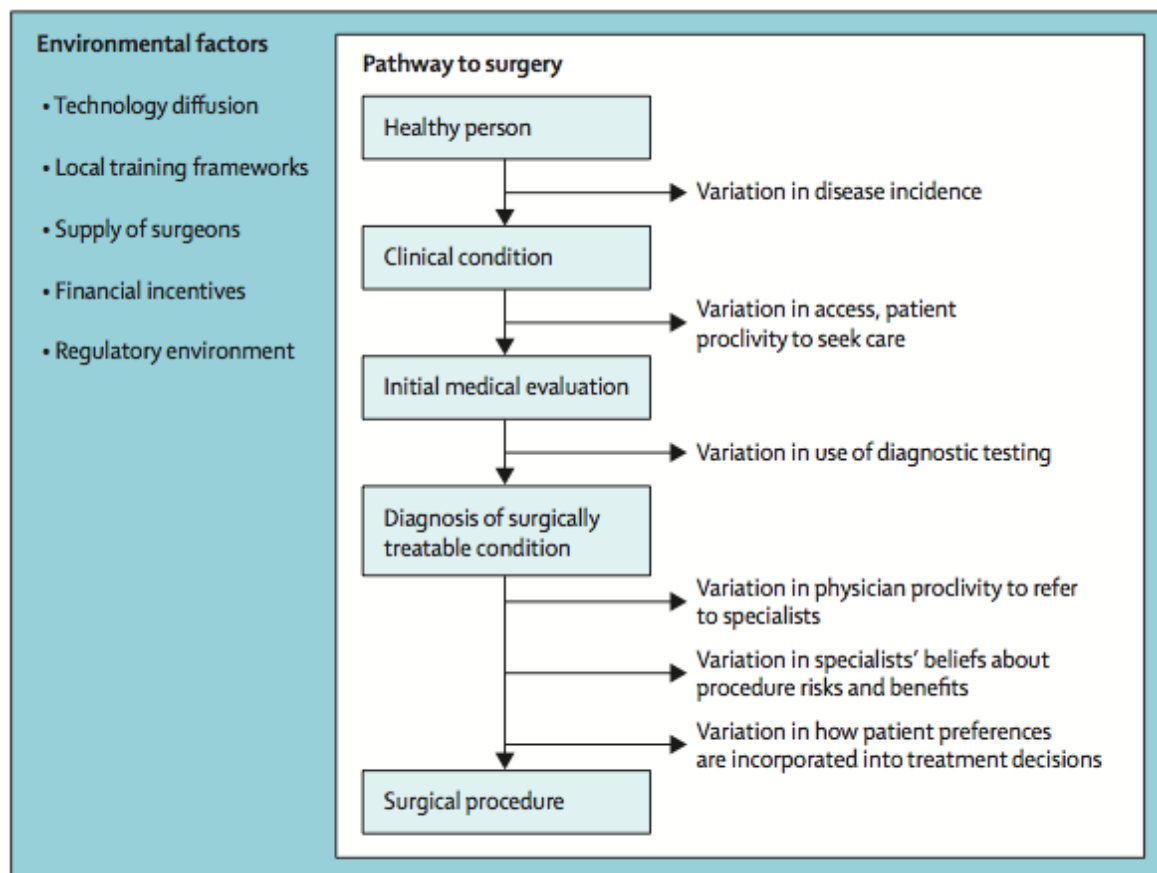
In 2014, Reames and colleagues published their results of a systematic review focusing on strategies for reducing regional variation in the use of surgery.(33) The review focused on two major strategies to improve consistency and the appropriateness of health care: dissemination of clinical practice guidelines or consensus statements, and shared decision-making tools and decision aids. Results for clinical guideline dissemination demonstrated varied results with some studies showing decreased procedure rates, but others showing no effect or increased rates. Recommendations for procedure choice generally showed a measurable increase in the use of the recommended procedure. With respect to BCT rates, some studies demonstrated a narrowed range of regional variation rates, while others demonstrated a wider range of procedural rates.(34) Decision aids have also shown mixed results, with three of five studies not showing a statistically significant change in rate of procedure after administration, while the other two studies have demonstrated discrepant effects – one study showing increased rates of BCT while the

other showed decreased rates. Although the overall findings show that both clinical guidelines and shared decision-making tools have the potential to substantially reduce the extent of variation in surgical care, these seem dependent on the clinical situation. These findings were confirmed by a recent Cochrane systematic review that have also shown decision aids were inconsistent in their ability to change outcomes in terms of surgical variation.(34)

To broadly examine influences on treatment decision-making, Birkmeyer and colleagues presented a conceptual model to examine regional variations in the use of surgery (Figure 2.5).(30) This model depicts the steps in the pathway from health and patient patient evaluation to the final surgical procedure, with potential influences on surgical variation. Many factors that may affect surgical rates that are independent of the surgeon, including disease incidence, access to health care, patient proclivity to seek care, diagnostic testing, and referral patterns of primary physicians. Physicians are well documented as having different opinions on optimal treatment or procedures and may be biased towards certain risks and benefits, which may account for regional variation. Furthermore, in preference-sensitive therapies differences in the degree to which physicians incorporated patients' values, beliefs, and preferences into the treatment decision may account for regional variations. The model also highlights other broad environmental factors that may affect regional variation in the use of surgery. The substantial increase in rates of cholecystectomy after the introduction of laparoscopic surgery exemplifies the concept of technology diffusion. Because physicians' practice tends to resemble the way they were trained, training can have significantly influence a region's 'surgical signature'.(35) Other factors such as financial incentives and regulatory

environment can also affect surgical variation; rates of procedures such as cataract surgery or arthroscopy done in privately owned outpatient ambulatory surgical centres are twice those of the same procedures done in the community hospital setting. The scope and focus of this model are intended to allow evaluation at the level of the surgical procedure, permitting comparisons and explanations of rates of a specific procedure amongst regions or comparison of different rates for different procedures. In following a patient's pathway to surgery, this model is well structured to capture the key factors that may influence and distinguish effective care, preference sensitive care, and supply-sensitive care.

Figure 2.5: Conceptual model of regional variation in the use of surgery

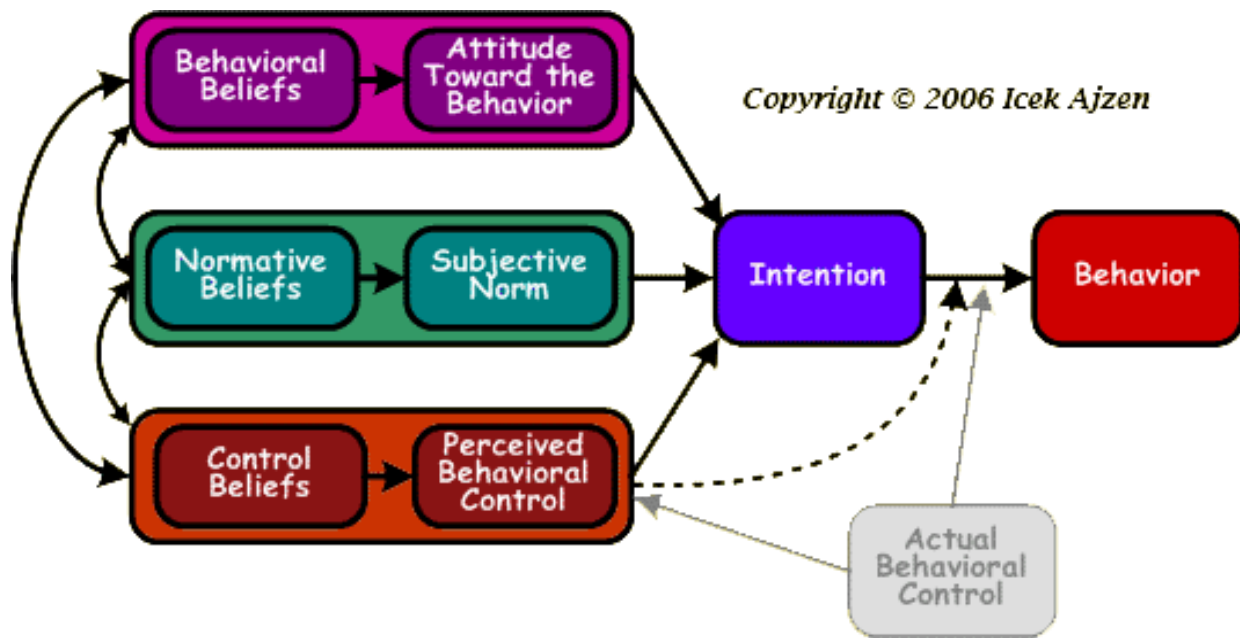


(30)

2.4 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a conceptual framework that links beliefs and behavior. Since its development, it has become one of the theories most commonly used theories to predict human functioning and behavior. The number of citations for the TPB totaled 4,550 in 2010 alone, and it has served as the model for more than 1,200 empirical studies of behavioral prediction and change.(36) The theory states that the most proximal determinant of a given behavior is intention, which represents the person's motivation or decision to act. Intention, in turn, is a function of three sets of belief-based perceptions of behavior: attitude toward the behavior, subjective norms, and perceived behavioral control (PBC). Attitude towards a behavior reflects a person's overall positive or negative feeling about performing the behavior. Subjective norm reflects the person's perception of the social pressure to perform a given behavior. PBC reflects a person's overall judgment about whether he or she has the ability and resources needed to engage in the target behavior. Figure 2.6 below depicts Ajzen's Theory of Planned Behavior.

Figure 2.6: Theory of Planned Behavior



(37)

This theory proposed by Icek Ajzen in 1985, was popularized by his 1991 article 'The Theory of Planned Behavior'.(38) This theory is an extension of an earlier model developed by Ajzen and Martin Fishbein, the Theory of Reasoned Action (TRA), to which the TPB added measures of control belief and perceived behavioral control as additional determinants of intentions and behavior. PBC was included to account for potential constraints on action as perceived by the actor, as well as to explain why intentions do not always predict behavior. In the TRA, it is assumed that people have volitional control over the behavior of interest and that they realize that they are capable of performing the behavior if they so desire. Under these conditions, perceived behavioral control becomes irrelevant, so that the theory of planned behavior reduces to the theory of reasoned action.(38)

Generally explained, the TRA states that if people evaluate a suggested behavior as positive (attitude towards behavior), and if they think that their significant others want them to perform the behavior (subjective norm), then they reach a higher level of intention

(motivation) and are thus more likely to perform the given behavior. When an individual's control over the behavior is incomplete, perceived behavioral control provides information about potential constraints on action, as perceived by the actor, and helps explain why behavioral intentions do not always predict actual behavior. The TPB comprises six constructs, as defined in by Icek Ajzen that collectively represent a person's actual control over the behavior(37,38):

Behavioral Beliefs → Behavioral beliefs link the behavior of interest to expected outcomes. A behavioral belief is the subjective probability that the behavior will produce a given outcome. Although a person may hold many behavioral beliefs with respect to any behavior, only a relatively small number are readily accessible at a given moment. It is assumed that these accessible beliefs – in combination with the subjective values of the expected outcomes – determine the prevailing attitude toward the behavior. Specifically, the evaluation of each outcome contributes to the attitude in proportion to the person's subjective probability that the behavior produces the outcome in question.

Attitude Toward the Behavior → Attitude toward behavior is the degree to which performance of the behavior is positively or negatively valued. According to the expectancy-value model, attitude toward a behavior is determined by the total set of accessible behavioral beliefs linking the behavior to various outcomes and other attributes. The strength of each behavioral belief is weighted by the evaluation of the outcome or attribute, and the products are aggregated, to produce a sum attitude.

Normative Beliefs → Normative beliefs refer to the perceived behavioral expectations of such important referent individuals or groups as the person's spouse, family, friends,

and – depending on the population and behavior studied – teacher, doctor, supervisor, and coworkers. It is assumed that these normative beliefs – in combination with the person's motivation to comply with the different referents – determine the prevailing subjective norm. Specifically, the motivation to comply with each referent contributes to the subjective norm in direct proportion to the person's subjective probability that the referent thinks the person should perform the behavior in question.

Subjective Norm → Subjective norm is perceived social pressure to engage or not to engage in a certain behavior. Drawing an analogy to expectancy-value model of attitude, it is assumed that subjective norm is determined by the total set of normative beliefs about the expectations of important referents. The strength of each normative belief is weighted by motivation to comply with the referent in question, and the products are aggregated, to produce a sum subjective norm.

Control Beliefs → Control beliefs have to do with the perceived pressure of factors that may facilitate or impede performance of a behavior. It is assumed that these control beliefs – in combination with the perceived power of each control factor – determine the prevailing perceived behavioral control. Specifically, the perceived power of each control factor to impede or facilitate performance of the behavior contributes to perceived behavioral control in direct proportion to the person's subjective probability of the control factor's being present.

Perceived Behavioral Control → Perceived behavioral control refers to people's perception of their ability to perform a given behavior. Drawing an analogy to the expectancy-value model of attitude, it is assumed that perceived behavioral control is determined by the total set of accessible control beliefs, i.e., beliefs about the presence

of factors that may facilitate or impede performance of the behavior. Specifically, the strength of each control belief is weighted by the perceived power of the control factor, and the products are aggregated, to produce a sum perceived behavioral control. To the extent that it is an accurate reflection of actual behavioral control, perceived behavioral control can, together with intention, be used to predict behavior.

Intention → Intention indicates of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior. The intention is based on attitude toward the behavior, subjective norm, and perceived behavioral control, with each predictor weighted for its importance in relation to the behavior and population of interest.

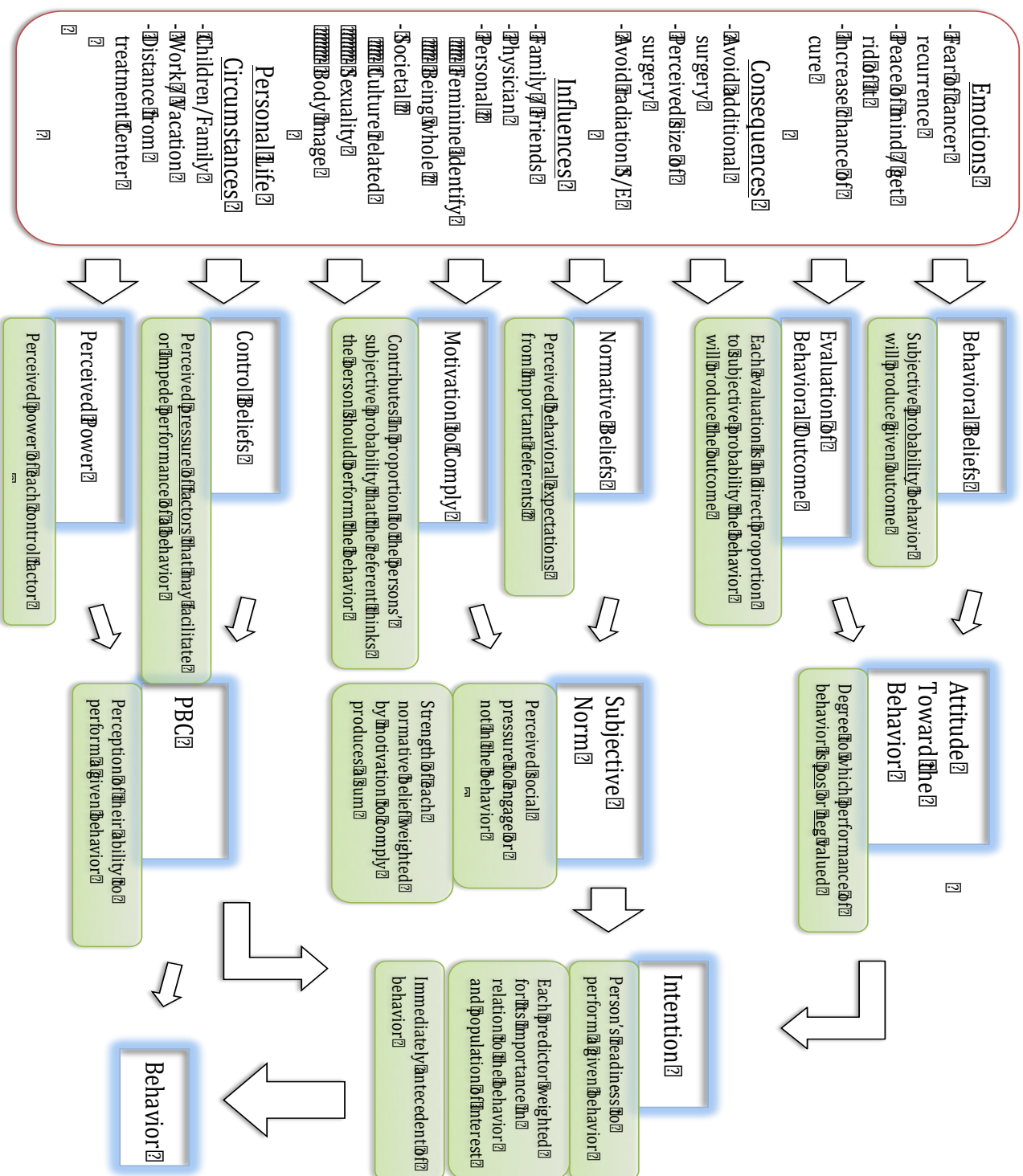
The TPB can be applied to decision-making for women whom have ESBC. The behavior of choosing mastectomy or BCT can be conceptualized as a planned decision. With respect to applying TPB to decision-making, Ajzen states that: '[t]he TPB emphasis is on the controlled aspects of human information processing and decision-making. Its concern is primarily with behaviors that are goal-directed and steered by conscious self-regulatory processes. From the TPB, expectations that performing a behavior will lead to experiencing pain, pleasure, regret, fear, elation, or other emotions are simply behavioral beliefs, i.e. beliefs about the likely consequences of the behavior, some positive and others negative'.(36) This theory has been utilized as a conceptual framework to study decision making in ESBC in past research.(39)

TPB can be used to conceptualize the variety of factors that may potentially influence a woman's choice of mastectomy or BCT. Using theoretical forestructure, hypothesized examples in relation to TPB are described hereafter. Sociodemographic

characteristics can have influences on all three of the belief constructs. Factors such as socioeconomic status or cultural background will directly relate to behavioral and normative beliefs. Personal life circumstances such as work obligations or distance from a treatment centre may heavily affect a person's control beliefs. The influences of close family members and friends or a surgeon's recommendations will be among the key referents involved in an individual's subjective norms. Emotions such as fear of cancer recurrence and desire for peace of mind are often very important determinants of a woman's choice of mastectomy. These behavioral beliefs can strongly affect her attitude towards the behavior as well as her subsequent behavioral intentions. Similarly, the value that individuals place on wanting to feel whole or on their feminine identity after treatment may strongly influence their behavioral beliefs. Figure 2.7 illustrates how the TPB can be used as a framework for considering the factors that influence a woman's choice between mastectomy and BCT in cases of ESBC.

Some potential limitations could hinder the use of TPB as a framework for examining factors that influence women's choice between mastectomy and BCT in the setting of ESBC. Application of the TPB assumes that the patient is explicitly aware that he or she has a choice of therapy, which is not always the case. Additionally, translating influencing factors that are analyzed as subjective norms or PBC for clinical understanding may pose a further challenge.

Figure 2.7: TPB applied to factors influencing decision-making between mastectomy versus BCT



2.5 Shared Decision-Making Framework

In 1999 Charles et al presented a conceptual framework for examining treatment decision-making that still informs decision-making concepts even in the absence of an agreed upon definition (Figure 2.8).(40) The framework includes three models of treatment decision-making included, which are the paternalistic model, shared model, and the informed model. Each models has three distinct steps, or analytic stages: information exchange, deliberation, and deciding on the treatment to implement. The framework describes the general path that each of the models follows as well as, more specifically, the behavioral expectations of both physicians and patients for implementation of each model. The separate analytic stages of each model make it easy to conceptually distinguish one model of treatment decision-making from another. The framework also recognizes the dynamic nature of decision-making and does not limit a single treatment interaction to one model, as the encounter may change as the interaction evolves.

Figure 2.8: Models of treatment decision-making

Models of treatment decision making^a

Analytical stages	Models	Paternalistic	(in between approaches)	Shared	(in between approaches)	Informed
Information exchange	Flow	One way (largely)		Two way		One way (largely)
	Direction	Physician → patient		Physician ↔ patient		Physician → patient
	Type	Medical		Medical and personal		Medical
	Amount ^b	Minimum legally required		All relevant for decision-making		All relevant for decision-making
Deliberation		Physician alone or with other physicians		Physician and patient (plus potential others)		Patient (plus potential others)
Deciding on treatment to implement		Physicians		Physician and patient		Patient

^a Illustration for an encounter focusing on the case of a (treating) physician–patient dyad. For more complex cases see text.

^b Minimum required.

(40)

Within this framework, decision-making is related to situations in which several treatment options are available that offer different benefits to risks ratios, and different patient outcomes. Charles identified four necessary characteristics:(41)

1. At minimum, both physicians and patients are involved in the treatment decision-making process.
2. Both physician and patients share information with each other.
3. Both physician and the patient take steps to participate in the decision-making process by expressing treatment preferences.
4. A treatment decision is made in which both the physician and patient agree on the treatment to implement.

In these appropriate situations, the three models can be divided into three analytically distinct situations to help distinguish their characteristics. Information exchange refers to the type and amount of information exchanged as well as the flow of information between physician and patient. Deliberation involves discussion of treatment options, and expression of treatment preferences. The final stage is the actual decision and choice of treatment to implement.(41)

The paternalistic model has traditionally been the predominant approach to treatment decision-making, in which it is generally assumed that the physician will make a better treatment decision than the patient would. In this model, information exchange is largely one-way in this model from physician to patient. The patient is generally a passive recipient, and information exchange from patient to physician is not seen as important to completing this interaction. During the deliberation stage, the physician considers the benefits and risks of each option alone or in consultation with other physicians, but the

patient is passive. The physician makes the final treatment decision alone. This model resembles a parent-child relationship, with an authority figure (the physician) making what is deemed to be the appropriate decision for the patient.(41)

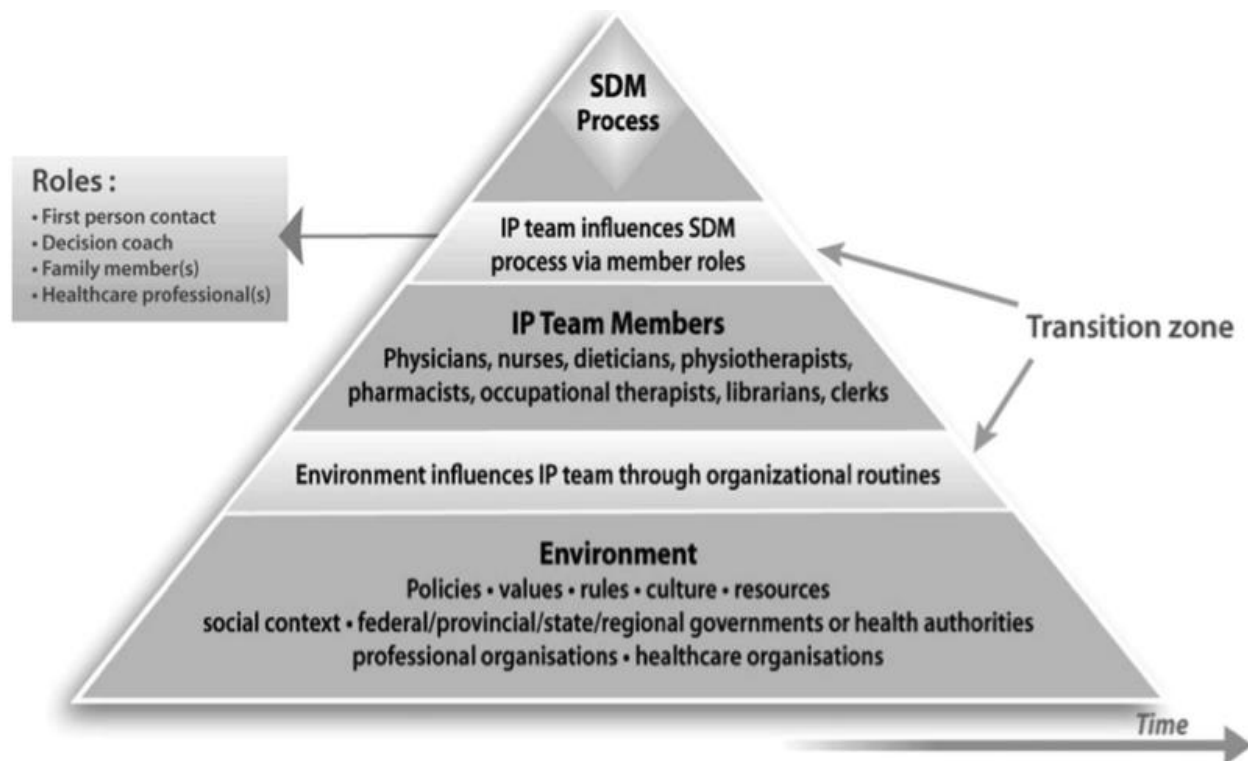
The shared decision-making (SDM) model evolved with clinical medicine as treatment options increased for diseases; accompanied by greater emphasis on discussion of trade-offs between risks and benefits. In this model, information exchange goes both ways. The physician should provide all of the relevant decision-making information to the patient, and the patient should provide information about issues related to the treatment options including values, preferences, social circumstances, and their knowledge about the illness. As a result, deliberation can occur within the boundaries and context of the patient's specific situation. Deliberation should be interactional in nature, with both members having input and being invested in the treatment decision. Expression of treatment preferences is important to this model. The decision on treatment should be agreed upon between both the physician and the patient.

The informed decision-making model differs from the SDM model in that the physician limits his or her primary role to providing information. Information exchange is thus largely one-way, so that the physician is the primary source of information for the patient, who weighs all of the treatment options and the benefits and risks of each option. Beyond information transfer, the physician does not participate further in the decision-making process, leaving the patient to deliberate and make the final choice on the treatment on his or her own. An important fundamental difference from the shared model is that the physician should not be invested in the decision-making process or in the decision made.

This is to avoid influencing the patient towards the physician's preferred treatment, which might not align with the interests of the patient.(41)

Recently, SDM scholars have urged the creation of a model that would extend beyond the physician-patient dyad to promotes an interprofessional approach to SDM. France Légaré, Dawn Stacey, et al. proposed a new model for interprofessional share decision-making (IP-SDM) with which to guide patient care.(42,43) The model has three levels: the individual (micro) level, the healthcare team/organization (meso) level, and the healthcare system (macro) level. (Figure 2.9) When used in an IP-SDM approach, this model assumes that multiple healthcare professionals are colloborating, concurrently or sequentially, to achieve SDM with the patient. The model also assumes that the clinical encounters cannot occur free of the influence of factors from the levels of the healthcare system. This model has the potential to unify the process of SDM in different healthcare settings and among different health professionals.(41)

Figure 2.9: IP-SDM model – healthcare system (meso and macro) levels representing the global influences in which the individual level is embedded



(43)

The individual level of care described by France Légaré et al. bears similarities to the Charles model,(41) but incorporates of multiple health care professionals, a decision coach, and family member involvement made explicit through the information, deliberation, and treatment decision stages. The meso level of the IP-SDM model is represented by the IP team members and includes the ways in which this team or organization functions. The macro level represents global healthcare environmental factors: resources, government policies, cultural values, professional organizations, and rules. Being a newly proposed model that has had limited development or application in real-world clinical scenarios, IP-SDM requires further work to clarify the meso and macro levels.(43,44) In Saskatchewan's ESBC setting, treatment decisions are made primarily with the involvement of a single healthcare professional, the surgeon. However, the expanding role and involvement of radiation oncology, which influences the length of radiation treatments; the increasing role

of adjuvant chemotherapy; and the involvement of nurse navigators may all have a roles in the IP-SDM model in the future.

2.6 Background Literature Summary

In cases of ESBC, multiple prospective randomized control trials with good long-term follow-up have established that BCT and mastectomy offer equivalent survival rates.(2–9) Current breast cancer management guidelines thus offer the option of BCT or mastectomy as an initial treatment for patients who have ESBC.(19,20) However, in 1990, the first NIH consensus conference on the treatment of ESBC recommended BCT as the ‘preferable’ primary therapy: ‘Breast conservation treatment is an appropriate method of primary therapy for the majority of women who have stage one or two breast cancer and is preferable because it provides survival rates equivalent to those of total mastectomy and axillary dissection while preserving the breast’.(10) The belief that BCT is preferable has been perpetuated throughout the breast cancer literature, including in the Canadian CPAC reports: ‘BCT is therefore generally recommended for most women with Stage I or II breast cancer.’(11).

Recently, two major national reports have used BCT and mastectomy rates as quality of care indicators.(12,27) The first, a report by CIHI and CPAC released in 2012, that looked at Canadian mastectomy rates from 2007 to 2010. The second, a CPAC update released in 2015, covered surgery from 2008 to 2013. Both reports final figures for national mastectomy rate and interprovincial differences were very similar. In the 2015 CPAC report, the Canadian final mastectomy rate was 38.1%, ranging from 25.3% in Quebec to 68.3% in Newfoundland and Labrador. As already noted, in Saskatchewan, the final mastectomy rate for invasive cancer was 63.4%. In the 2012 report, the group ran a

regression model that included age, neighbourhood income quintile, and travel time to the closest cancer centre so as to adjust for potential factors influencing mastectomy rates. However, the discrepancies in provincial mastectomy rates were only marginally reduced even when adjusting for other factors, for a 26-percentage point absolute difference between the highest and lowest mastectomy provinces (35% to 61%). Saskatchewan remained the second highest, with an adjusted mastectomy rate of 60%. This report's conclusions included a recognition of the limitations of its analysis and suggested examination of local practice patterns to better understand patient factors affecting decision-making.

Regional variation in surgery is not unique to treatment of ESBC, being a well-documented phenomenon throughout medical practice for many surgical procedures. Practice variations between procedures can be grouped into three categories; effective care, preference-sensitive care, and supply sensitive care.(32) Effective care includes treatments for which good evidence supports a single intervention, with no good alternative options available. Examples included colectomy for colon cancer or repair of a hip fracture. Variations in this category generally suggest inappropriate underutilization in lower use areas. Preference-sensitive care includes interventions for problems having more than one acceptable treatment option, such as radical prostatectomy, radiotherapy, or active surveillance for prostate cancers and BCT or mastectomy for ESBC. Ideally, differences vary with patient preferences and values, but they could potentially vary for other reasons as well. Supply-sensitive care includes services that are limited by the resource availability, such as of physician visits, hospital beds or specialist consultations. Most surgical interventions do not fall under this category. Preference-sensitive care represents the

largest of the category for surgery, including decision-making between mastectomy and BCT in cases of ESBC.

The choice of mastectomy versus BCT is complicated, as there are many factors that influence therapy choice. Birkmeyer and colleagues presented a broad pathway model to evaluate the steps a patient takes from being a healthy individual to reaching the final surgical procedure, highlighting potential influencing factors along the pathway, such as variations in access, diagnostic testing, local training frameworks, physicians beliefs about procedures, and patient preferences.(30) On an individual patient level, the theory of planned behavior is a more appropriate framework for conceptualizing and theoretically explaining the ways in which a variety of factors may potentially influence a woman's choice of therapy.(36,38) Interactions between the patient and physician are also complex; Charles et al. presented models of treatment decision-making between the dyad that offer insights into understanding its components by breaking down the steps of the interaction.(40,41) These frameworks and models were important in guiding our research, and subsequent chapters elaborate on their use.

CHAPTER 3, MANUSCRIPT #1: REVIEW OF FACTORS INFLUENCING WOMEN'S CHOICE OF MASTECTOMY VERSUS BREAST CONSERVING THERAPY IN EARLY STAGE BREAST CANCER: A SYSTEMATIC REVIEW

3.1 Article Citation:

Gu J, Groot G, Boden C, Busch A, Holtslander L, Lim H. Review of Factors Influencing Women's Choice of Mastectomy Versus Breast Conserving Therapy in Early Stage Breast Cancer: A Systematic Review. Clin Breast Cancer. 2018 Aug;18(4):e539–54.

Content included in this article does not significantly differ from the published manuscript. However, grammatical modifications have been made, and the document has been reformatted from the original version for inclusion in this thesis.

3.2 Abstract

Background: No previous systematic review on this topic exists.

Methods: We have performed a narrative synthesis. A literature search was conducted between January 2000 to June 2014 in seven databases. Initial search identified 2717 articles, 319 underwent abstract screening, 67 underwent full-text screening, and 25 final articles were included. This review looked at ESBC in women only, excluding DCIS and advanced breast cancer. A conceptual framework was created to organize the central constructs underlying women's choices: clinicopathological factors, physician factors, and individual factors with subgroups sociodemographic, geographical, and personal beliefs and preferences. This framework guided our review's synthesis and analysis.

Results: Larger tumor size and increasing stage was associated with increased rates of mastectomy. Results for age varied but suggested that old and young extremes of diagnostic age were associated with an increased likelihood of mastectomy. Higher socioeconomic status was associated with higher BCT rates. Resident rural location and increasing distance from radiation treatment facilities were associated with lower rates of BCT. Individual belief factors influencing women's choice of mastectomy (mastectomy being reassuring, avoiding radiation, an expedient treatment) differed from factors influencing choice of BCT (body image and femininity, physician recommendation, survival equivalence, less surgery.) Surgeon factors including female sex, higher case number, and individual surgeon practice were associated with increased BCT rates.

Conclusions: The decision-making process for women with ESBC is complicated and affected by multiple factors. Organizing these factors into central constructs of

clinicopathological, individual, and physician factors may aid health-care professionals to better understand this process.

3.3 Key Words

Breast cancer; decision-making; mastectomy; breast conserving therapy.

3.4 Background

Breast cancer is the most commonly diagnosed cancer and the second most common cause of cancer death in women in North America.(11) Landmark trials have established breast conservation therapy (BCT) and mastectomy offer equivalent survival and can be viewed as equivalent treatments in early stage breast cancer (ESBC).(2–4,6) With equivalence of treatments, surgery for ESBC is often viewed and described as a preference-sensitive care.(32) Decision-making and variations in procedure rates should be ideally due to underlying patient preferences and values. However, since the seminal National Institute of Health Consensus Conference in 1999 recommended BCT as ‘preferable’,(10) there have been ongoing questions and research regarding quality of care as it relates to regional variation in BCT rates for treatment of ESBC.(45) Viewing procedural variation as a result of patient preferences compared to evaluating low BCT rates as a failure of meeting recommendations are dichotomous views. In Canada, there has been significant variation across the country with mastectomy rates ranging from 26% to 69% between provinces.(12) There has been similarly drastic variation in the United States and the United Kingdom that is not well explained.(46,47)

The choice of mastectomy versus BCT is a complicated decision-making process; administrators should look beyond just mastectomy rates and aim to understand the reason behind these variations. The literature trying to identify factors that influence a woman’s choice between mastectomy and BCT for treatment of ESBC is heterogeneous in study design with limited experimental or prospective evidence. No systematic reviews evaluating this topic currently exist in the literature. Mac Bride et al have recently published a non-systematic review paper highlighting factors associated with therapy

choice.(13) They identified some key factors in the literature including patient sociodemographic factors, geographical factors, role of the surgeon, role of reconstruction, and influence of MRI use. However, this review included studies looking at Ductal Carcinoma in Situ (DCIS), which is a different disease process.(13) Furthermore, the review did not integrate literature covering other key components in decision-making including individual patient preference factors and clinicopathological factors such as tumor size. The aim of this systematic review is to provide a rigorous synthesis of the factors influencing women's choice between mastectomy versus BCT with ESBC.

3.5 Methods

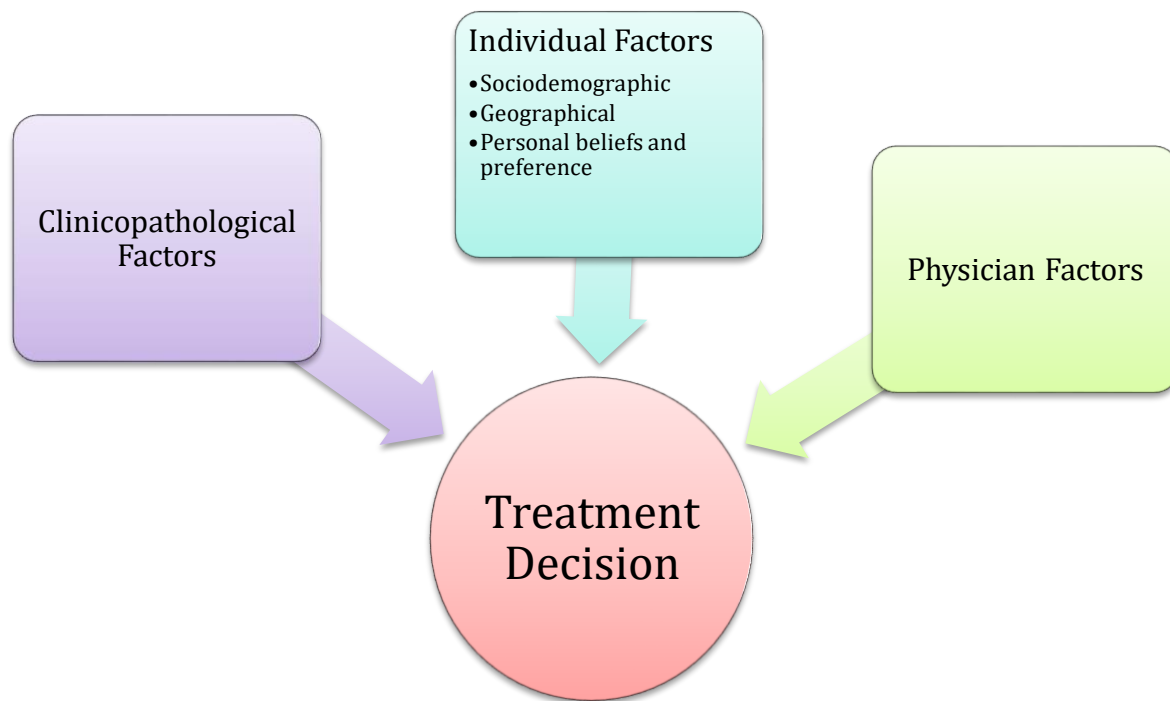
Because this review question is complex and underlying factors influencing decision-making are numerous, the systematic review team has chosen to perform a narrative synthesis as described by Popay.(48) This synthesis method is ideal when there is considerable heterogeneity amongst the included studies in terms of methods, participants and a wide array of reported outcomes as is the case for factors influencing women's choice of mastectomy versus BCT. A systematic review methodology was adopted that allowed inclusion of both quantitative and qualitative papers. Methods adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA).(49)

3.5.1 Conceptual Framework

In surveying the literature, most research done in this area was conducted in a shotgun approach without a guiding framework. Each study generally only captured small portions of influencing factors without appropriate consideration of the phenomenon as a whole. As a first step to synthesizing the impact of these factors, we created a conceptual

framework that illustrates the central constructs underlying women's choices (Figure 3.1). This framework provided a comprehensive basis to guide our review from conduct to the synthesis and analysis. Women's choice of mastectomy versus BCT can be organized into three broad influencing constructs: clinicopathological factors, physician factors, and individual factors with subgroups of sociodemographic, geographic, and individual belief factors. This framework was developed through integrating previous frameworks, theories, models, literature, and clinical research.

Figure 3.1: Conceptual framework illustrating the central constructs influencing women's choice between mastectomy versus BCT



3.5.2 Search Strategy and Information Sources

In collaboration with the team's librarian, a Population, Intervention, Comparison, Outcome (PICO) strategy was adopted to clearly define our research question for a comprehensive literature search. The PICO concepts for the search were breast cancer,

mastectomy, breast conservation therapy, and decision-making. Controlled vocabulary and natural language terms were identified for each of the four concepts. The terms for the 'breast cancer, 'mastectomy', and 'breast conservation therapy' concepts were derived in part from a Cochrane Breast Cancer Group search strategy.(50) An Epoch search strategy was adopted and amended for the term 'decision making'.(51) Our search strategy was peer-reviewed by another librarian (V.D.), who is experienced in systematic reviews, using Peer Review of Electronic Search Strategies (PRESS).(52) Limits were set for the English language and a date of 2000 – current. This date limit was chosen because BCT was universally accepted as an equivalent treatment to mastectomy by 2000. English language was chosen for comparable cultures. No other search limits were applied. An initial literature search was conducted on August 21st, 2013. An example of the final Medline search strategy can be seen in Appendix B. The original databases chosen for our search were Medline, Embase, CINAHL, and PubMed. It was subsequently decided by the research team to expand the database search to include Scopus, Web of Science, and PsycINFO. Expansion of our search was to ensure our review was in line with an inclusive search strategy and with previous reviews done on this topic. The final search was conducted on June 5th, 2014. Database searches from the original literature search were updated to include articles up to June 5th, and the additional databases were searched from 2000 to June 5th, 2014. Below lists the final 7 databases included in the review:

Ovid Medline (R) – (1946-), searched 2000 to June 5th, 2014

Ovid Embase – (1947-), searched 2000 to June 5th, 2014

EBSCO CINAHL – (1937-), searched 2000 to June 5th, 2014

PubMed – searched 2013 to June 5th, 2014

Scopus – (1823-), searched 2000 to June 5th, 2014

Web of Science – (1899-), searched 2000 to June 5th, 2014

PsycINFO – (1806-) searched 2000 to June 5th, 2014

Duplicate records were removed from the search results and the records were stored in Refworks bibliographic management tool. Additionally, reference sections of key articles included were reviewed to identify potentially missed articles.

3.5.3 Study Selection

Two primary reviewers independently screened all articles in title screening, abstract screening, and full-text screening stages. Standardized forms were created for the review process and an online application, DistillerSR, was used to facilitate the screening process.(53) As part of an inclusive strategy, both reviewers were required to agree on exclusion for the article to be excluded during title screening. When screening abstracts and full-text articles, all conflicts were flagged for a third expert reviewer to resolve. Articles were included only if they met the following pre-specified inclusion criteria: a primary study or review, a full-length article, English text, published from 2000 onwards, a geographical location with culture comparable to North America, looking at simple stage 1 and 2 breast cancer only (DCIS, stage 3 and 4 cancer, BRCA+, male breast cancer, and inflammatory breast cancer were excluded), radiation being a standard part of BCT treatment, and the focus of the study was on factors influencing the decision-making of the patient (not decision aids, etc). Specific inclusion and exclusion criteria for each stage of screening were decided and reviewed, in whole, by the systematic review team. The screening questions and forms are attached in Appendix C.

3.5.4 Data Collection

Included studies were grouped into either qualitative or quantitative articles. The two researchers performing data extraction (J.G. and K.S.) both have MDs and were PhD students in epidemiology. This optimized both content knowledge on breast cancer and epidemiology. Data was independently extracted and in duplicate. An online application, Google Drive, was used to facilitate data extraction. A data extraction form was piloted from key references and was modified as further studies were examined. Separate forms were created for univariate data and multivariate data.

3.5.5 Assessment of Bias

Study designs were separated into quantitative studies, qualitative, or mixed-methods studies. For quantitative studies, the Newcastle-Ottawa Scale (NOS) was the primary tool used for assessment of bias.(54) The use of the NOS has been popular in systematic reviews of non-randomized studies, and has been regarded as effective and easy to use.(55) Furthermore, this scale considers three fundamental domains: appropriate selection of participants, appropriate measurement of variables, and appropriate control of confounding.(56) In an attempt to mitigate some of the weakness of a single assessment tool, we have chosen to add a summary score of overall quality of study. Two researchers (J.G. and K.S.) independently evaluated all included quantitative studies in duplicate, and disagreements were resolved through discussion (Table 3.1).

Qualitative studies were evaluated using a modified version of the Critical Appraisal Skills Programme (CASP) scale, which has been used in qualitative reviews in the past.(57,58) Two researchers, the lead author (J.G.) and a qualitative expert (L.H.)

independently evaluated all qualitative articles in duplicate. Disputes were resolved through discussion (Table 3.2).

Table 3.1: NOS assessment of bias for quantitative articles

Refid	Author / Reference	NOS-J	NOS-K	Overall-J	Overall-K	J-S	J-C	J-O/E	K-S	K-C	K-O/E
105	Lee et al., 2012	7	8	Strong	Strong	4	2	2	4	2	3
112	Dhage et al., 2011	4	6	Weak	Strong	2	0	2	4	0	2
176	Hershman et al., 2009	7	9	Medium	Strong	3	2	3	4	2	3
208	Reitsamer et al., 2008	8	8	Strong	Strong	3	2	3	3	2	3
223	Sauerzapf et al., 2007	8	9	Strong	Strong	3	2	3	4	2	3
246	Temple et al., 2006	8	7	Strong	Strong	3	2	3	4	3	1
258	Celaya et al., 2005	8	9	Strong	Strong	3	2	3	4	2	3
259	Osborn et al., 2005	9	7	Strong	Strong	4	2	3	4	2	3
263	Chagpar et al., 2005	8	9	Medium	Strong	3	2	3	4	2	3
292	Locker et al., 2004	7	9	Medium	Strong	3	1	3	4	2	3
294	Molenaar et al., 2004	8	8	Strong	Strong	4	2	2	4	2	2
318	Schou et al., 2002	5	5	Medium	Medium	4	0	1	4	0	1
329	Mastaglia et al., 2001	6	5	Medium	Medium	4	0	2	4	2	0
330	Keating et al., 2001	8	8	Strong	Strong	4	2	2	4	2	2
340	Cyran et al., 2001	8	6	Medium	Medium	4	2	2	4	0	2
341	Benedict et al., 2001	6	5	Medium	Medium	4	0	2	4	0	2
343	Nold et al., 2000	5	4	Poor	Medium	4	0	1	4	0	0
386	Boscoe et al., 2011	7	7	Strong	Strong	3	2	2	4	2	1
771	Roder et al., 2014	9	9	Strong	Strong	4	2	3	4	2	3
1096	Kelemen et al., 2001	8	8	Strong	Strong	4	2	2	4	2	2
1160	Maskarinec et al., 2002	8	8	Strong	Strong	4	2	2	4	2	2
1206	Olaya et al., 2009	8	8	Strong	Strong	4	2	2	4	2	2

NOS denotes Newcastle-Ottawa Scale; J denotes researcher J.G.; K denotes researcher K.S.; S = selection subscale; C = comparability subscale; O/E denotes outcome or assessment of exposure subscale

Table 3.2: CASP scores for qualitative articles

Refid	Author / Reference	Aims	Methodology	Overall-J	Overall-L	Average Score (24)
110	Caldon et al., 2011	Yes	Yes	19	21	20
337	Mcvea et al., 2001	Yes	Yes	17	16	16.5
503	Kiloran et al., 2006	Yes	Yes	19	19	19

J denotes researcher J.G.; L denotes researcher L.H.

3.5.6 Synthesis and Analysis

Narrative synthesis was done following methods described by Popay (2006), (48) and general review principles described by Booth (2012)(59) were followed. The four main elements of synthesis described are (1): developing a theoretical model of how the interventions work, why, and for whom, (2) developing a preliminary synthesis, (3) exploring relationships in the data, and (4) assessing the robustness of the synthesis product. Developing a theoretical model and performing a preliminary synthesis was an iterative process. As previously described, the factors influencing decision-making between mastectomy and BCT are multifactorial and the literature is heterogeneous. We developed a conceptual framework to guide organization of results for more systematic synthesis and analysis. The five constructs in our conceptual model guiding our review are clinicopathological factors, demographic factors, geographical factors, individual belief factors, and surgeon-related factors. This is illustrated in Figure 3.1.

All included studies were examined for reported results in any of the key constructs from our framework. Articles were then categorized based on the constructs reported. An article could be placed into multiple categories if they addressed multiple constructs. This resulted in 11 articles reporting clinicopathological factors, 15 articles reporting the

demographic factor age, 7 articles reporting geographical factors, 11 articles reporting individual belief factors, and 10 articles reporting physician-related factors. All articles within each grouping were then individually examined for the reported outcome variables within the construct category. Detailed information regarding each study including method of analysis, predicting variables, outcome, and variable reporting were recorded. This process was carried out through all five constructs and initial results were summarized. A meta-analysis was originally planned, but due to the heterogeneity of the reported outcomes, we determined no meaningful meta-analysis could be conducted for any group. Instead, we identified key factors within each construct and performed a narrative synthesis.

There were three qualitative studies included in our review. These were reviewed (J.G. and L.H.) and we decided that there was not enough data to perform a meta-synthesis or thematic synthesis. These articles fell under the individual belief factors construct and were integrated into the individual belief constructs synthesis and analysis.

3.5.7 Risk of Bias Across Studies

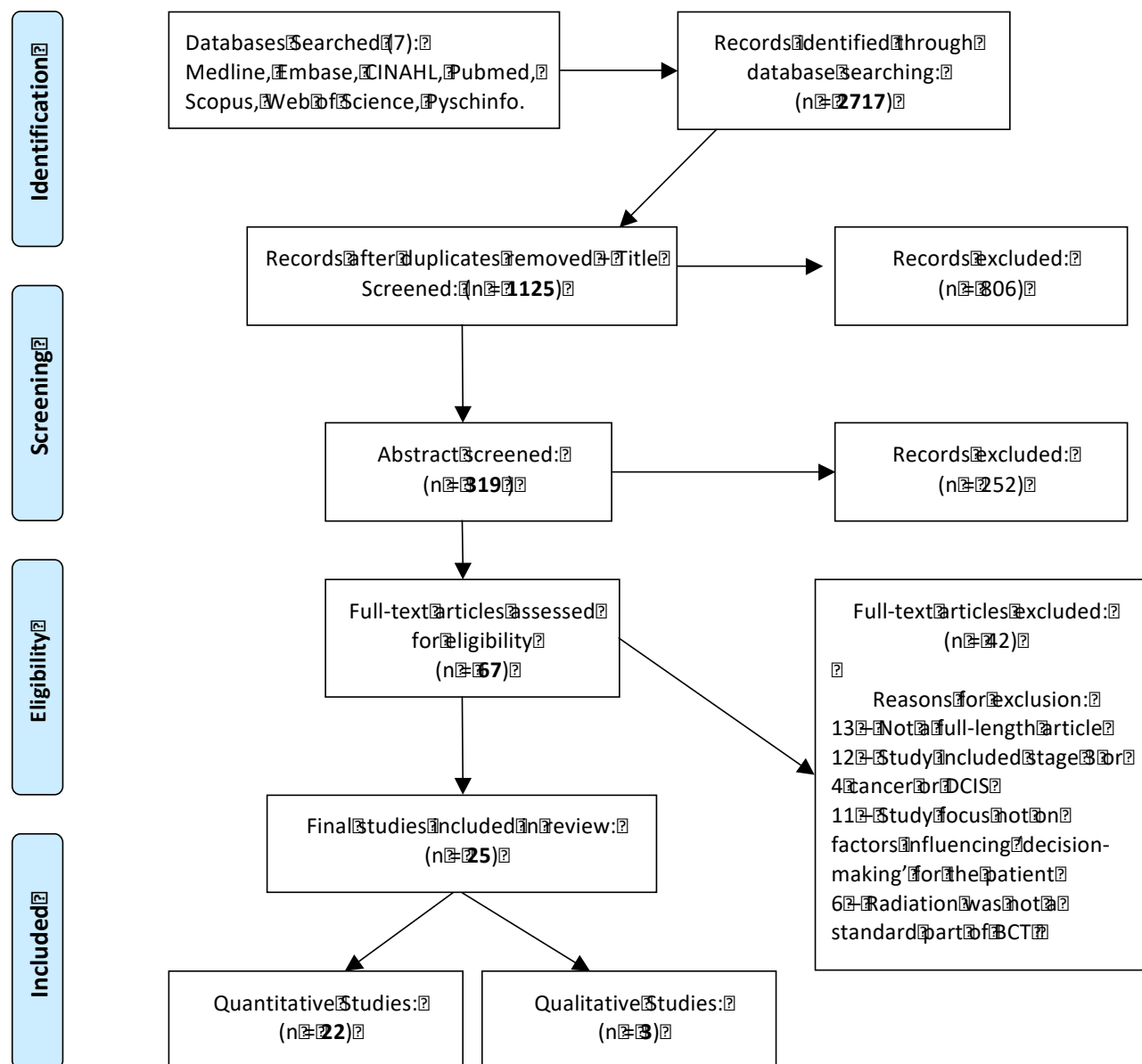
Due to the level of heterogeneity between studies, assessing risk of bias across studies was not feasible in this review for quantitative and qualitative articles. All given results from included articles were incorporated into our analysis to minimize selective reporting within studies.

3.6 Results

3.6.1 Study Selection

Figure 3.2 illustrates our flow diagram. After de-duplication, the initial database search identified 1125 articles that underwent title screening. 319 articles moved on to abstract screening, and 67 articles underwent full-text screening, resulting in 25 articles meeting our final inclusion criteria. 22 articles were quantitative, 3 were qualitative, and 1 was mixed-methods, which was grouped with the quantitative articles.

Figure 3.2: Systematic review flow diagram



3.6.2 Study Characteristics

Study characteristics including study design, country of study, sample size, mastectomy rate, BCT rate, and study duration are shown in Table 3.3. A total of 274,416 patients were included in the studies. There were 15 studies from the USA, 3 from the UK, 2 from Australia, and 1 from Norway, Austria, and the Netherlands.

Table 3.3: Summary of study characteristics

Refid	Author / Reference	Study Design	Country	N	Mast N (%)	BCT N (%)	Study Duration
105	Lee et al., 2012	Cross-Sectional	USA	383	272 (71.1%)	111 (29.0%)	2008(Oct) – 2011(Feb)
110	Caldon et al., 2011	Qualitative	UK	64	16 (25.0%)	48 (75.0%)	
112	Dhage et al., 2011	Cross-Sectional	USA	243	69 (28.3%)	174 (71.6%)	2004 – 2008
176	Hershman et al., 2009	Cross-Sectional	USA	56,768	30,006 (52.9%)	26,762 (47.1%)	1991(Jan) – 2002(Dec)
208	Reitsamer et al., 2008	Cross-Sectional	Austria	495	120 (24.2%)	375 (75.8%)	2002 – 2004
223	Sauerzapf et al., 2007	Cross-Sectional	UK	5,830	4,525 (77.6%)	1,305 (22.4%)	1994(Jan) – 2002(Dec)
246	Temple et al., 2006	Cohort	Canada	157	45 (28.7%)	112 (71.3%)	1992 – 1995
258	Celaya et al., 2005	Cross-Sectional	USA	2,861	978 (65.8%)	1,883 (34.2%)	1998 – 2001
259	Osborn et al., 2005	Mixed-Methods	UK	202	81 (40.1%)	121 (59.9%)	2000(Jun) – 2000(Jul)
263	Chagpar et al., 2005	Cohort	USA	4,086	1,324 (32.4%)	2,762 (67.6%)	1998(May)– 2004(Aug)
292	Locker et al., 2004	Cross-Sectional	USA	9,365	4,467 (47.7%)	4,898 (52.3%)	1996(Aug)– 2000(Mar)
294	Molenaar et al., 2004	Cross-Sectional / Quasi-Experimental	Netherlands	172	49 (28.5%)	123 (71.5%)	1996 – 1999
318	Schou et al., 2002	Cross-Sectional	Norway	194	87 (44.8%)	107 (55.2%)	1999(Sep)– 2001(Aug)
329	Mastaglia et al., 2001	Cross-Sectional	Australia	165	70 (42.4%)	95 (57.6%)	1996(Oct)– 1997(Mar)
330	Keating et al., 2001	Cross-Sectional	USA	2,426	1,056 (43.5%)	1,370 (56.5%)	1993(Sep) – 1995(Oct)
337	Mcvea et al., 2001	Qualitative	USA	N/A,	N/A	N/A	
340	Cyran et al., 2001	Cross-Sectional	USA	176	96 (54.5%)	80 (45.5%)	1991(Jan) – 1996(Dec)
341	Benedict et al., 2001	Cross-Sectional	USA	192	157 (81.8%)	35 (18.2%)	1995 – 1998
343	Nold et al., 2000	Cross-Sectional	USA	96	43 (44.7%)	53 (55.2%)	1994 – 1999
386	Boscoe et al., 2011	Cross-Sectional	USA	104,730	34,980 (33.4%)	69,750 (66.6%)	2004 – 2006
503	Kiloran et al., 2006	Qualitative	USA	N/A,	N/A	N/A	
771	Roder et al., 2014	Cross-Sectional	Australia	30,299	11,729 (38.7%)	18,570 (61.3%)	1998 – 2010
1096	Kelemen et al., 2001	Cross-Sectional	USA	7,815	5,537 (70.8%)	2,278 (29.1%)	1986(Jan) – 1996(Dec)
1160	Maskarinec et al., 2002	Cross-Sectional	USA	722	341 (47.2%)	381 (52.8%)	1995 – 1998
1206	Olaya et al., 2009	Cross-Sectional	USA	47,837	13,023 (27.2%)	34,814 (72.8%)	1996 – 2005

Sum				274,831	108,783 (39.6%)	166,048 (60.4%)	
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Synthesis of Results

3.6.3 Clinicopathological Factors

Table 3.4: Tumor size and stage results

Author / Reference	N	Country	Predicting	Variables	Analysis*	Larger T-Size / Stage Predicting
Lee et al., 2012	383	USA	Mast	Just stage	Uni and Multi	Mastectomy
Dhage et al., 2011	243	USA	Group Comparison	Just stage, t-test only	Group Comparison	Mastectomy
Hersman et al., 2009	56,768	USA	BCS	Stage, hormone receptor, grade	Uni and Multi	Mastectomy
Reitsamer et al., 2008	495	Austria	Mast	T-size, hormone receptor, histology, grade, L.N. Status, localization,	Uni and Multi	Mastectomy
Celaya et al., 2005	2,861	USA	BCT	T-size	Multi	Mastectomy
Osborn et al., 2005	202	UK	Group Comparison	Just T-size,	Group Comparison	Mastectomy
Chagpar et al., 2005	4,086	USA	BCT	T-size, palpability, histology, location	Group Comparison and Multi	Mastectomy
Locker et al., 2004	9,365	USA	Mast	T-size, hormone receptor, grade, L.N. status	Uni and Multi	Mastectomy
Roder et al., 2014	30,299	Australia	Mast	T-size, Lymphovascular invasion	Uni and Multi	Mastectomy
Kelemen et al., 2001	7,815	USA	BCT	T-size	Uni and Multi	Mastectomy
Maskarinec et al., 2002	722	USA	BCT	Stage, T-size, Grade	Uni and Multi	Mastectomy

* Uni denotes univariate analysis; multi denotes multivariate analysis; L.N. denotes lymph node

Table 3.5: Other clinicopathological factors reported

Author / Reference	N	Country	Predicting	Variables	Analysis*
Hersman et al., 2009	56,768	USA	BCS	Hormone receptor, grade, differentiation	Uni and Multi
Reitsamer et al., 2008	495	Austria	Mast	Hormone receptor, histology, grade, L.N. Status, localization,	Uni and Multi

Chagpar et al., 2005	4,086	USA	BCT	Histology, palpability, location	Group Comparison and Multi
Locker et al., 2004	9,365	USA	Mast	Hormone receptor, grade, L.N. status	Uni and Multi
Roder et al., 2014	3,029	Australia	Mast	Hormone receptor, histology, grade, L.N. status, lymphovascular invasion, multifocality	Uni and Multi
Maskarinec et al., 2002	722	USA	BCT	Grade	Uni and Multi

* Uni denotes univariate analysis; multi denotes multivariate analysis; L.N. denotes lymph node

Eleven studies looked at clinicopathological factors. Various factors were examined across studies including, stage, tumor size, nodal status, hormone receptor status, grade, histology, and presence of lymphovascular invasion. Many of these items were addressed in only a few studies and did show a significant impact on undergoing mastectomy or BCT. The factors most commonly examined in the articles were tumor size and stage (Table 3.4), which are closely related in ESBC. These were also the most commonly significant factors. Other clinicopathological factors examined in multiple studies were grade, hormone receptor status, and tumor histology (Table 3.5). Category stratification amongst these factors varied too greatly to perform a meta-analysis on any of these categories.

Studies looking at stage reported decreasing BCT rates with higher stage of cancer.(60) A large database review by Hersmen et al. showed women were significantly less likely to undergo BCT with Stage II compared to Stage I disease [OR, 0.33, 95% CI, 0.36–0.39].(61) Celeya et al. reported similar findings of decreasing likelihood of BCT with increasing cancer stage, IIA [OR, 0.57, 95% CI, 0.45–0.72] and IIB [OR, 0.28, 95% CI, 0.20–

0.39] compared with stage I.(62) In a survey study by Lee et al., there was a trend for women with stage II, compared with stage I disease, to be more likely to undergo mastectomy [OR, 1.81, 95% CI, 0.89–3.68].(45)

All studies looking at tumor size showed increased rates of mastectomy with a larger tumor size. Roder et al. reported tumors larger than 4cm were significantly less likely to undergo BCT compared to those less than 3cm [OR, 1.09, 95% CI, 1.02–1.17].(14) Locker et al. found tumor size >2cm was associated with increased likelihood of undergoing mastectomy [OR, 3.03, 95% CI, 2.74–3.35](63) while Kelemen et al. found BCT more likely with tumor size <2cm [OR, 2.46, 95% CI, 2.20–2.76].(46) Reitsamer et al. reported similar findings of decreasing likelihood of undergoing mastectomy with smaller tumor size, T1c [OR, 0.43, 95% CI, 0.24–0.77] and T1b [OR, 0.32, 95% CI, 0.13–0.81] compared with T2 tumors.(64) A different study compared mean tumor diameter found the BCT treatment group had significantly smaller tumors compared to the mastectomy group, 15mm compared to 17mm [p=0.14].(65) Two other studies, Mascarenic et al and Chagpar et al. also supported the association between higher mastectomy rates with larger tumor sizes.(66,67)

3.6.4 Individual Sociodemographic Factors

Table 3.6: Age as a factor results

Refid	N	Predicting	Variables	Analysis*	Older Age Grp	Younger Age Grp	Findings
105	383	Mast	Age at diagnosis, % older than 50 yo	Uni	BCT	Mast	BCT = 66.2% Mast = 52.3%
112	243	Group Comparison	Mean age at diagnosis	Grp Comp	BCT	Mast	BCT = 60 yo Mast = 54yo
176	56,768	BCT	Age at dx: 65-69, 70-74, 75-79, 80+	Uni and Multi	Mast	BCT	All older age groups more likely to undergo mast

208	495	Mast	Age at dx: <50, 50-69, 70+	Uni and Multi	Not significant (trend to mast)	Not significant (trend to mast)	Not significant (Trend: Old + younger = mast, middle = BCT)
223	5,830	BCT, Group Comparison	Age at dx: <50, 50-59, 60-69, 70-79, 80+	Uni	Mast	BCT	All older age groups more likely to undergo mast
258	2,861	BCT	Age at dx: <44, 45-54, 55-64, 65-74, 75+	Uni and Multi	Mast	BCT	Increasing age = more likely to undergo mast
259	202	Descriptive	Mean age at diagnosis	Grp Comp	Mast	BCT	Mast = 61 yo BCT = 55 yo
263	4,086	BCT	Age at dx <55 vs >55	Grp Comp and Multi	Mast	BCT	Younger than 55 yo = BCT
292	9,365	Mast	Age at dx: <60, 60-69, >70	Uni and Multi	Mast	BCT	All older age groups more likely to undergo mast
340	176	BCT, Group Comparison	Mean age at dx, age ≥75	Grp Comp and Multi	BCT	Mast	Age ≥ 75 more likely to undergo BCT
341	192	Grp Comparison	Mean age at diagnosis	Grp Comp	Not significant (trend to mast)	Not significant (trend to BCT)	Not significant (Mast = 57.4 yo BCT = 54.2 yo)
386	104,730	Mast	Age: 65+, 50-64, <50	Multi	Mast	Mast	Old + younger = mast, middle = BCT
1096	7,815	BCT	Mean age at dx, age <55	Grp Comp and Multi	Mast	BCT	Younger than 55 yo = mast
1160	722	BCT	Age at diagnosis: <50, 50-64, 65+	Uni (not sig)	Not significant (trend to mast)	Not significant (trend to mast)	Not significant (Trend: Old + younger = mast, middle = BCT)
1206	47,837	BCT, Group Comparison	Age at diagnosis: <40, 40-64, ≥65	Grp Comp and Multi	Mast	Mast	Old + younger = mast, middle = BCT

* Uni denotes univariate analysis; multi denotes multivariate analysis

Table 3.7: Individual sociodemographic factors results

Refid	N	Predicting	Variables	Analysis*	Findings (not including age)
105	383	Mast	Age, Race, Education, Marital Status, Annual Income	Uni and Multi	None significant in multivariate modelling
112	243	Group Comparison	Age, Education, Annual Income, Race	Grp Comp	Differences in mean age, education, and race
176	56,768	BCT	Age, Race, Marital Status, SES	Uni and Multi	Race → black more likely to undergo BCT, Hispanic = no difference, other = more likely to undergo mastectomy SES → higher SES more likely to undergo BCT Married → more likely to undergo BCT
208	495	Mast	Age only	Uni and	N/A

				Multi	
223	5,830	BCT, Group Comparison	Age, Deprivation	Uni	Deprivation → more deprived quartiles less likely to undergo BCT
258	2,861	BCT	Age, Marital Status	Uni and Multi	None significant
259	202	Descriptive	Age, Partner Status	Grp Comp	Partner = more likely to undergo mastectomy
263	4,086	BCT	Age only	Grp Comp and Multi	N/A
292	9,365	Mast	Age, Body weight, BMI	Uni + Multi	Body weight > 70kg more likely to undergo BCT
340	176	BCT, Group Comparison	Age, Race/Ethnicity, Education	Grp Comp and Multi	Education ≥ high school = more likely to undergo BCT Race → not significant
341	192	Grp Comparison	Age, Education level, Marital status, Income, Employment, Insurance	Grp Comp	Education = college associated with higher BCT Income = higher income associated with BCT
386	104,730	Mast	Age, Race, Ethnicity, Poverty rate	Multi	Race = Asian and unknown more likely to undergo mastectomy, Black and American Indian = no difference Ethnicity = Hispanic more likely to undergo mast
1096	7,815	BCT	Age only	Grp Comp and Multi	N/A
1160	722	BCT	Age, ethnicity, marital status,	Uni (not sig)	None significant
1206	47,837	BCT, Group Comparison	Age, SES, race/ethnicity	Grp Comp and Multi	SES → higher SES more likely to undergo BCT Race → Non-Hispanic black more likely to undergo BCT, Asian/Pacific Islander more likely to undergo mastectomy, Hispanic = no difference from White.

* Uni denotes univariate analysis; multi denotes multivariate analysis

Fifteen studies examined sociodemographic factors influence on choice of mastectomy versus BCT. All of these studies considered age as potential influencing factor (Table 3.6). Other sociodemographic factors reported in the literature include socioeconomic status (SES), race/ethnicity together or separate, education, marital status, annual income, area deprivation, poverty, body weight, BMI, employment, and insurance (Table 3.7). Even looking just at age, measures differed significantly throughout the studies with many considering averages such as means or medians, while others used various

cutoffs for group comparison from younger and older than 55 years old to 75 years old, or various stratified groupings. There were mixed results for the effect of age on treatment choice. Higher SES was linked to higher rates of BCT. Asian ethnicity was linked to higher rates of mastectomy, Black race was linked to higher rates of BCT, and other ethnic groups showed mixed results.

For older women, most studies and the studies with better quality data supported increasing age favoring mastectomy. Nine of the studies concluded this with most studies having good sample sizes and six of the studies utilizing stratified age analysis. In contrast, only three studies favored older women choosing BCT, all of which had sample sizes under 400 and used an average age comparison. Locker et al. conducted a review of data from the ATAC trial involving over 9000 patients and found older age groups were more likely to undergo mastectomy.(63) Compared to women diagnosed under the age of 60, those diagnosed from 60-69[OR, 1.28, 95%CI, 1.15–1.43], and ≥ 70 [OR, 2.22, 95%CI, 1.95–2.52] were more likely to have mastectomy. In a SEER database review of 56,000 patients over 64 years old, Hershman et al. also found increasing age was associated with decreasing likelihood of undergoing BCT.(61) Specifically, compared to a reference age of 65-69, all age groups including 70-74[OR, 0.91, 95%CI, 0.87–0.96], 75-79[OR, 0.83, 95%CI, 0.78–0.87], and 80+[OR, 0.77, 95%CI, 0.73–0.82] were less likely to undergo BCT.

Two other large studies not only found older women were more likely to undergo mastectomy, but also younger women, with the middle age groups being relatively more likely to choose BCT. Olaya et al. conducted a database review of the California Cancer Registry of more than 47,000 patients and found compared to women diagnosed at age 40-64, those aged less than 40[OR, 0.73, 95%CI, 0.66–0.81] and those older than 64[OR, 0.85

95%CI, 0.81–0.89] were less likely to have BCT.(68) In another review of a large SEER database of over 100,000 patients, Boscoe et al. reported compared to women aged 65 and older, those 50-64 were less likely to have mastectomy [OR, 0.93, 95%CI, 0.90–0.96], and those younger than 50 were more likely to have mastectomy [OR, 1.31, 95%CI, 1.26–1.36].(69)

Other studies have shown younger women were more likely to undergo BCT. Two studies found that women aged younger than 55 were more likely to undergo BCT compared to those older than 55, Chagpar et al.(66) [OR, 1.46, 95%CI, 1.247–1.699] and Kelemen et al.(46) [OR, 1.22, 95%CI, 1.10–1.35]. Sauerzapf et al. conducted a chart review over 6000 patients the UK and found compared to women aged <50, other older age groups were significantly less likely to undergo BCT: 60-69[OR, 0.74, 95%CI, 0.61–0.89], 70-79[OR, 0.37, 95%CI, 0.30–0.45], and over 80[OR, 0.32, 95%CI, 0.23–0.44].(70)

Multiple studies found higher SES, or other indicators of SES including education and income associated with increased likelihood of BCT. Two large SEER database studies based in the USA found incremental increases in BCT rates with improving SES group.(61,68) SES was calculated based on participant's zip code and census data from 2000 in both studies. Olaya et al. found that compared to SES quintile 1 (lowest SES), patients from quintiles 3 to 5 were significantly more likely to undergo BCT 3[OR, 1.34, 95%CI, 1.09–1.29], 4[OR, 1.53, 95%CI, 1.42–1.67], and 5[OR, 1.86, 95%CI, 1.72–2.01].(68) A UK-based study by Sauzerpauf et al. found similar results using the Index of Multiple Deprivation, a measure of poverty.(70) This study found that compared to the least deprived quartile, patients in the most deprived quartile were significantly less likely to undergo BCT[OR, 0.62, 95%CI, 0.54–0.72].(70) A smaller survey conducted by Benedict et al. found the average income and

education level were significantly higher with individuals choosing BCT compared to mastectomy.(71)

Studies measuring race and ethnicity varied in how they captured and grouped their information, but there were trends that Asian/Pacific Islander women were more likely to undergo mastectomy, while Non-Hispanic Black women were more likely to undergo BCT. Two studies reported that compared to White race, black or Non-Hispanic Black race was associated with increased rates of BCT, Hershman et al.(61) [OR, 1.19, 95%CI, 1.08–1.29] and Olaya et al.(68) [OR, 1.25, 95%CI, 1.13–1.39]. Conversely, two studies found Asian/Pacific Islander race associated with decreased likelihood of undergoing BCT, Olaya et al.(68) [OR, 0.61, 95%CI, 0.57–0.65] and Boscoe et al.(69) reported their results as increased likelihood of undergoing mastectomy[OR, 1.70, 95%CI, 1.60–1.80]. There were mixed or non-significant results for other race/ethnicities.

3.6.5 Geographical Factors

Table 3.8: Geographical factors results

Author / Reference	N	Predicting	Variables	Analysis*	Findings
Hershman et al., 2009	56,768	BCT	Resident location (metropolitan vs non-metropolitan)	Uni and Multi	Non-metropolitan = lower BCT rate
Sauerzapf et al., 2007	5,830	BCT, Group Comparison	Travel time to RT facility, Lives within 800m of bus service, ward with community transport	Group Comparison, Uni	Travel time to RT = no difference. No bus service = higher mastectomy rate
Celaya et al., 2005	2,861	BCT	Distance to RT facility (straight line) (mi)	Uni and Multi	Increased distance to RT facility = lower BCT rate
Mastaglia et al., 2001	165	Group Comparison	Resident location (urban vs rural)	Group Comparison	Rural = lower BCT rate
Cyran et al., 2001	176	Group Comparison	Resident location (urban vs rural)	Group Comparison	No difference

Boscoe et al., 2011	104,730	Mast	Distance to RT facility (by roads in km), Distance to surgery (by roads in km)	Multi	Increased distance to RT facility = lower BCT rate Increased distance to surgery centre = lower BCT rate
Roder et al., 2014	30,299	Mast	Resident location (major city, inner regional, more remote)	Uni and Multi	More remote location = higher mastectomy rate

* Uni denotes univariate analysis; multi denotes multivariate analysis; RT denotes radiation treatment

Seven studies looked at geographical factors influencing mastectomy versus BCT.

The variables reported include resident location, travel time or distance to a radiation treatment facility, living distance to bus service, wards with community transport, and distance to surgery centre (Table 3.8). The two most commonly examined factors were resident location and travel distance or time to a radiation treatment facility. Although some studies found no difference, most studies showed rural location and increased distance to a radiation facility were associated with lower rates of BCT. All studies were based in the USA, Australia, or the UK. Because the categories and definitions of variable were so mixed, no meta-analysis was possible for geographical factors.

Four studies focused on resident location. In a large USA SEER database study looking at over 56,000 patients, Hersman et al. found individuals residing in non-metropolitan areas were significantly less likely to undergo BCT on both univariate and multivariate analysis [OR, 0.43, 95% CI, 0.40–0.45].(61) Similarly, a large Australian database study conducted by Roder et al. found resident remoteness associated with increased rates of mastectomy [RR, 1.38, 95% CI, 1.23–1.54].(14) In their multivariate models, compared with major city residence, inner regional [RR, 1.05, 95% CI, 0.99–1.11] and more remote areas [RR, 1.09, 95% CI, 1.00–1.17] were still slightly more likely to

undergo mastectomy. In a smaller study, Mastaglia et al. also found women living in rural locations were more likely to choose mastectomy rather than BCT [χ^2 , 12.75, $p=0.00$].(72) Cyran et al. was the only study looking at resident location that did not find a significant difference between women living in rural or urban areas when it came to rates of mastectomy versus BCT[$p=0.20$].(16)

The three studies looking at living distance to a radiation facility were all travel focused studies examining related factors that may predict treatment choice. Both Celaya et al.(62) and Boscoe et al.(69) were US based studies that found individuals living farther from radiation treatment centres were less likely to undergo BCT. Celeya et al. found women living <20 miles from radiation treatment facility were at a decreased likelihood of undergoing BCT compared to women living at 20-40 miles [OR, 0.65, 95% CI, 0.53–0.79] and >60 miles [OR, 0.31, 95% CI, 0.15–0.65].(62) Boscoe et al. reported likelihood of mastectomy increased monotonically with increasing distances to both the nearest surgical and radiation treatment centres. For distance to a radiation treatment centre, the highest increase was found at 75– 100km [OR, 1.43, 95% CI, 1.23–1.65].(69) The UK study conducted by Sauzerpf et al. found differing results. They found that both distance to a radiation facility and estimated travel time were not predictors of treatment choice. The only exception found was women living further than 800m from a public transport service were less likely to undergo BCT.(70)

3.6.6 Individual Belief Factors

Table 3.9: Individual belief factors results

Author / Reference	Study Design	N	Predicting	Analysis*	Findings
Lee et al., 2012	Cross-Sectional	383	Mastectomy and BCT underlying reasons	Questionnaire – Uni and multivariate	Mastectomy – to gain peace of mind, avoiding radiation

					BCT – keeping your breast
Caldon et al., 2011	Qualitative	64	Mastectomy and BCT underlying reasons	Qualitative – Framework Approach	Mastectomy – fear of recurrence, BCT – body image concerns Both – least disruptive treatment, anecdotal experiences
Temple et al., 2006	Cohort	157	Mastectomy and BCT underlying reasons	Questionnaire – Uni and multivariate	Mastectomy – concerns about recurrence BCT – importance of breast to sexuality
Osborn et al., 2005	Mixed-Methods	202	Mastectomy and BCT underlying reasons	Structured interviews – analysis not specified	Mastectomy - fear of cancer recurrence, potential side effects of radiotherapy, wanting a rapid solution BCT – local excision less disfiguring, less surgery involved, long-term outcome same as mastectomy
Molenaar et al., 2004	Cross-Sectional / Quasi-Experimental	172	Mastectomy and BCT underlying reasons	Questionnaire – Uni and multivariate, grp comparison	Mastectomy – concern local recurrence BCT = concern loss of breast
Schou et al., 2002	Cross-Sectional	194	Mastectomy and BCT underlying reasons	Questionnaire – grp comparison, correlational	Mastectomy – fear of recurrence BCT – femininity, physical appearance
Mastaglia et al., 2001	Cross-Sectional	165	Mastectomy and BCT underlying reasons	Questionnaire – grp comparison	Mastectomy – no significant findings BCT – surgeon’s preference, no difference in survival
Mcvea et al., 2001	Qualitative	43	Mastectomy and BCT underlying reasons	Qualitative – template Style	Mastectomy – more expedient, lower risk of LR BCT – comfortable with potential risks of LR, more aggressive local therapy unnecessary, maintain body image
Benedict et al., 2001	Cross-Sectional	192	Mastectomy and BCT underlying reasons	Questionnaire – analysis not specified	Mastectomy – cure rate better, quickly getting rid of cancer cells, avoiding radiation BCT – cure rate as good, appearance better
Nold et al., 2000	Cross-Sectional	96	Mastectomy and BCT underlying reasons	Questionnaire – grp comparison,	Mastectomy – fear of breast cancer and recurrence, concern about radiation BCT – surgeon influence
Kiloran et al., 2006	Qualitative	62	Mastectomy and BCT underlying (Chinese-US patients)	Qualitative – general qualitative	Mastectomy –based in vanity and therefore not safe, aesthetics not important, MRM safer BCT – physician recommendation

* Uni denotes univariate analysis; multi denotes multivariate analysis

Eleven studies looked at individual belief factors (Table 3.9). The majority of studies were survey-based and three of the studies were qualitative. Methodologically, they varied

greatly; specifically, data gathering and analysis. For questionnaires, there were differences in the number of individual factors provided, the wording of these factors, and whether they were rated on Likert scales or ranking lists. The analysis and reporting methods were also diverse from group comparisons to multivariate modeling. The qualitative studies also had varying methods. Specific methods and primary findings of each study are shown in Table 3.9. Overall, the main themes influencing women's choice of mastectomy were mastectomy being the most reassuring option, avoiding radiation, and a more expedient treatment. The main themes influencing women's choice of BCT were body image concerns and femininity, physician recommendation, long-term survival being equivalent, and less surgery being involved.

The most common individual belief factors influencing choice of mastectomy can be grouped around the theme of mastectomy being the most reassuring option. This term was reported as fear of recurrence in six studies, gaining peace of mind in one study, and mastectomy being safer than BCT in 1 study. Schou et al. found individuals rating 'fear of cancer recurrence' highly correlated with choice of mastectomy [$r_s = 0.43, p = 0.000$].(73) Both Temple et al.[$p = 0.001$](39) and Molenaar et al.[$p < 0.001$](17) found women who underwent mastectomy rated fear of cancer recurrence significantly higher compared to women who underwent BCT. Lee et al. found those rating 'removing your entire breast to gain peace of mind' were significantly more likely to undergo mastectomy as well [OR, 1.88, 95%CI, 1.60–2.20].(45) In a qualitative study, Caldon et al. reported 'most reassuring treatment' as the primary reason women chose mastectomy, further stating 'many choosing mastectomy said this option reduced their anxiety about the completeness of cancer

excision...".(47) In another qualitative study, Killoran et al. described 'choosing BCT was inherently a decision based in vanity and was therefore not safe.'(74)

The other individual belief factors found to influence mastectomy are avoiding radiation and being a more expedient treatment. Four studies reported 'avoiding radiation' or 'potential side effects of radiotherapy' as a significant factor influencing choice of mastectomy. Lee et al. found those rating 'avoiding having radiation' were significantly more likely to undergo mastectomy [OR, 1.23, 95%CI, 1.11–1.36].(45) Two studies reported patients choosing mastectomy because it provided a rapid solution for domestic or employment reasons.(65,75) McVea et al. conducted a qualitative study that reported "their decisions were based primarily on their preference for the option that was more expedient."(75)

The most common individual belief factor influencing the choice of BCT was related to body image concerns and femininity. Although potentially distinct, these two ideas were often not separated in the literature and often reported together or as connected. The exact terminology used in studies varied greatly including: 'less disfiguring', 'physical appearance', 'appearance better', 'keeping your breast', 'local excision less disfiguring', and 'importance of breast to sexuality'. Temple et al. found women who rated the factor 'importance of breast to sexuality' highly was predictive of choice of BCT [95%CI difference in proportions %, 4.5–32.3, $p=0.007$].(39) This factor was related to 'importance of breasts to feelings of being feminine' in the study. Schou et al. found both 'femininity' [$r_s= 0.26$, $p=0.000$] and 'physical appearance' [$r_s= 0.21$, $p=0.004$] correlated with choice of BCT.(73) This was similarly found in a qualitative study by Caldon et al. who reported 'body image concerns predominated among those choosing BCT'.(47) Lee et al. also found women rating

‘keeping your breast’ significantly less likely to undergo mastectomy compared with BCT [OR, 0.79, 95%CI, 0.70–0.88].(45)

The other individual belief factors that were important for choice of BCT were physician recommendation, long-term survival being equivalent, and less surgery being involved. In a survey by Mastaglia et al., patients rated a list of factors that influenced their treatment decision. ‘Knowing my surgeon’s preference for the type of surgery’ was rated significantly higher for women choosing BCT compared to mastectomy [t=-2.30, p=0.023].(72) Nold et al. found similar results; the surgeon was significantly more influential in affecting choice of procedure for BCT rather than mastectomy[p<0.05].(76) A study by Benedict et al. found the most important factor for women’s choice of BCT was ‘cure rate being equivalent between treatments’.(71) Mastaglia et al. found patients choosing BCT rated ‘no difference in survival’ significantly more important than those who chose mastectomy [t=-3.33, p=0.001].(72) This was similarly reported in a qualitative study by McVea et al.: ‘these women chose BCT reportedly because they felt comfortable with the potential risks of local recurrence, felt more aggressive local therapy was unnecessary...’.(75)

3.6.7 Physician-Related Factors

Table 3.10: Physician-related factors results

Author / Reference	N	Predicting	Variables	Analysis*	Findings
Hershman et al., 2009	56,768	BCT	Surgeon demographics – Degree, Country of training, year of graduation, type of practice, No. of procedures (over cohort period), Gender	Uni and Multi	US-trained, >10 operations, graduation after 1975, and female sex → increased BCT rates
Reitsamer et al., 2008	495	Mast	Surgeon Comparison	Uni and Multi	Individual surgeon → predictor of mastectomy
Temple et al., 2006	157	BCT	Surgeon Comparison	Uni and Multi	Individual surgeon → predictive of mastectomy

Chagpar et al., 2005	4,086	BCT	Surgeon demographics – No. of cases / year, % of practice breast-related, academic affiliation	Uni and Multi	Academic affiliation → increased BCT rates
Keating et al., 2001	2,426	BCT	Medical Oncology consultation	Propensity analysis	Consultation with a medical oncologist → increased BCT rates
Cyran et al., 2001	176	Group Comparison, BCT	Primary physician in treatment planning (surgeon vs non), sex	Grp Comp and Multi	Female sex → increased BCT rates
Benedict et al., 2001	192	Group Comparison	Physician treatment recommendation	Grp Comp	No difference between groups
Roder et al., 2014	30,299	Mast	No. of cases / year (mean per year)	Uni and Multi	Case load ≤ 10 → increased mast rates

* Uni denotes univariate analysis; multi denotes multivariate analysis

Nine studies examined how physician-related factors influenced patient's choice of mastectomy versus BCT. The variables reported included comparing individual surgeon's rates of BCT, medical oncology consultation, physician treatment recommendation, and specific surgeon demographics such as medical degree, country of training, gender, or number of procedures. Research design and factors investigated varied throughout the studies (Table 3.10). Overall, studies suggested female gender, higher case number, training, and individual surgeon practice in at a breast unit were associated with increased BCT rates.

Hershmen et al. conducted a large SEER database review with over 56,000 patients; this study looked at the most influential surgeon-related characteristics. They found increased BCT rates associated with multiple characteristics including being US-trained [OR, 1.12, 95% CI, 1.03–1.22], performing >10 BCT procedures [OR, 1.29, 95% CI, 1.21–1.38], year of graduation after 1975 [OR, 1.16, 95% CI, 1.08–1.25], and the most influential being female gender [OR, 1.40, 95% CI, 1.25–1.55].(61) A much smaller survey of Colorado women by Cyran et al. also found female physician gender associated with increased BCT rates [OR, 3.8, 95% CI, 1.21–14.4].(16)

There were a few studies to suggest that individual surgeons have varying practices and procedure rates. Reitsamer et al. conducted a single centre review of 3 specialized high volume breast surgeons, each with over 50 cases per year. After controlling for patient and tumor factors, compared to surgeon C, both surgeon A [OR, 2.88, 95% CI, 1.48–5.60] and surgeon B [OR, 2.63, 95% CI, 1.34–5.16] were significantly more likely to have patients undergo mastectomy.(64) Temple et al. similarly found that an individual surgeon was a predictor of being less likely to undergo BCT [95%CI difference in proportions %, 8.3–55.5, p=0.08].(39)

Roder et al. conducted a large database review in Australia with over 30,000 patients. They found surgeons with a mean annual breast surgery case load ≤ 10 associated with an increased likelihood of undergoing mastectomy [OR, 1.15, 95% CI, 1.05–1.25].(14) Chagpar et al. reviewed a Louisville breast sentinel lymph node study of more than 3,000 patients. They found academic affiliation associated with increased BCT rates. [OR, 1.193, 95% CI, 1.021–1.393].(66)

3.7 Discussion

The analysis and interpretation of this systematic review utilizes our conceptual framework of why women choose mastectomy versus BCT (Figure 3.1). Each construct was grouped and analyzed separately – clinicopathological factors, physician-related factors, and individual factors with subgroups of sociodemographic factors, geographical factors, and personal belief and preferences factors. The strength of conclusions that can be drawn from each of these constructs differs based on the results.

Amongst the clinicopathological factors, larger tumor size, and therefore stage, is the clearest factor that is consistently associated with increased mastectomy rates. This is likely

multifactorial in reason. A larger tumor implies a potentially more technically challenging operation, and has been associated with an increased likelihood of requiring a re-excision.(77,78) Furthermore, increasing tumor size has been associated with increased local recurrence rates.(22,23,79) Larger tumor size may also mean a poorer cosmetic outcome. These may all potentially bias the physician towards mastectomy and recommendation against BCT to the patient. Additionally, a larger tumor may influence the patient's perception of the severity of disease, as well as their belief and faith in the effectiveness of BCT.

For physician-related factors, we found data supporting female gender, higher case number, training, and individual surgeon practice variation were associated with increased BCT rates. Variations due to individual surgeon or surgeon gender certainly raise questions about how surgeons are influencing patient decision-making. If variations are due to better facilitation of patients' treatment preferences, then some variation in procedure rates are acceptable. However, if these variations are due to individual physician bias, poor communication styles, or other innate characteristics like empathy and personality, this may reflect a poor standard of cancer care.

The decision-making process between the physician-patient dyad is complicated and the details of the interaction are difficult to capture. There has recently been increasing research in this area; one popular model being adopted to capture this interaction is the shared decision-making (SDM) model.(41,43) This model breaks down the different steps in the treatment decision-making process and the individual roles through each step between physician and patient. In future research, we suggest it is not enough to capture only surgeon demographic characteristics, but also investigate the physician-patient

interaction to deepen the understanding of appropriateness and quality of this interaction. Researchers may wish to utilize a model like the SDM to ground their inquiries.

For sociodemographic factors, age was the most prevalent that was reported. As detailed in the results, differing studies drew different conclusions as to how age affected treatment choice. The most consistent results from the literature, with good stratified analysis, seem to suggest that the extremes of diagnostic age are associated with increased likelihood of mastectomy. There have been various explanations hypothesized over how age leads to varying treatment choice. Some have hypothesized that women diagnosed at a young age are choosing mastectomy due to fear of recurrence; the increasing rates of contralateral prophylactic mastectomy in the young age group seems to support this.(80–82) Alternatively, women of older age may choose mastectomy for a more expedient treatment, avoiding six weeks of radiation, and place less value on the cosmetic outcome as age increases. Another mechanism to explain the influence of age on treatment choice may be to view it as a moderator in the decision-making process for breast cancer instead of it being the main influence underlying treatment choice. For example, a woman may choose mastectomy because of fear of cancer recurrence, and diagnosis at a young age amplifies or increases this patient's fear.

Higher SES was repeatedly found to be associated with higher BCT rates.(61,68) The exact mechanisms causing this disparity are not clear. Is it related to income and/or education? Is it life-circumstances that limit individuals' abilities to comply with six weeks of adjuvant radiation? There have been studies associating lower SES with later presentation of disease, which may influence both the patient and physician towards choosing mastectomy.(83,84) These finding raise many questions related to accessibility

and quality of care. If patients of low SES groups do not feel supported in their ability to undergo BCT, these hurdles need to be identified so strategies can be put in place to address their needs. Perhaps more time needs to be spent with patients from lower SES groups to explain treatment options and explore availability of local support programs, such as lodging and other social services aid.

For geographical factors, most studies suggest that both resident rural location as well as increasing distance from radiation treatment facilities are associated with lower rates of BCT. The obvious conclusion is that because radiation treatment requires daily appointments for 4 to 6 weeks, both travel and/or accommodation may be significant in limiting patients' choice. Furthermore, the potential financial, family, and overall life-impact may be more for those living far from rural locations. Other possible explanations for varying rates would include culture or community influences from rural areas on effectiveness of treatments, or wishing to avoid aspects of treatments such as radiation.

Although individual belief factors may be one of the most important set of factors influencing women's decision-making, it is the most difficult and often least well studied. To practically capture this information, researchers are required at the minimum to utilize questionnaires or interviews, which is unfortunately impractical and too resource intensive for large-scale studies. Studies examining individual preferences frequently found women chose mastectomy because it was the most reassuring option, and this was often the most important reason behind their treatment choice.(16,17,39,73,85) More recent studies have found this belief is complicated and that worry about cancer recurrence was always due to a secondary underlying reasons – observing failed BCT treatments, avoiding follow-up imaging, or family history of breast cancer.(86) The other individual belief factors found to

influence choice of mastectomy were avoiding radiation and being a more expedient treatment. As outlined in the results, many of these studies were survey or interview based with relatively small sample sizes. It would be interesting to see in larger scale studies how incorporation of individual belief factors such as avoiding radiation interacted with geographical factors such as rural location would affect the impact of each factor on BCT rates. The main themes influencing women's choice of BCT were body image concerns and femininity, physician recommendation, long-term survival being equivalent, and less surgery being involved.

If variations in procedure rates are assumed to be due underlying patient values and preferences, why have there been ongoing questions and research (45,69) regarding quality of care as it relates to regional variation for treatment of ESBC? This stems from the seminal National Institute of Health (NIH) Consensus Conference in 1999, which recommended BCT as 'preferable' because it was thought to be less invasive and cosmetically superior.(10) Subsequently, mastectomy rates have been used by health care researchers and policy makers as an indicator of quality of breast cancer care.(87) Researches have frequently cited 'underuse' of BCT(16) and even gone as far as calling BCT the 'standard of care' in some studies.(64) However, viewing procedural variation as a result of patient preferences compared to evaluating low BCT rates as a failure of meeting recommendations are dichotomous views.

There has been a recent shift in thinking away from looking at just mastectomy rates and placing more focus on patient-centered care and SDM.(40) With newer research, there is increasing evidence that many patients choose mastectomy for many of their own reasons. As well, some studies have even demonstrated that if physicians recommended a

procedure to patients, BCT was usually suggested. Some authors have even suggested that the use of mastectomy rates as a quality indicator may actually bias the physician treatment against patients' wishes.(88) One study found decreased patient satisfaction and physician trust if surgeons attempt to push BCT as the treatment modality to patients who truly preferred mastectomy.(74) With this shift, there is beginning to be more acceptance of higher mastectomy rates if they vary for underlying patient preferences and not other reasons.(89) Within Canada, this is reflected in the latest 2015 Canadian Partnership Against Cancer(27) report that stated 'the interprovincial differences do not necessarily reflect differences in the appropriateness of treatment or the quality of care'(p.82). They further go on to state that there are no formal Canadian performance targets for actual treatment rates.

3.8 Conclusions

This review provides a good summary of the factors influencing why patients choose mastectomy versus BCT. By utilizing a conceptual framework, we have organized the numerous factors under broader constructs, which will provide clinicians a logical framework for consideration while counseling patients. We strongly suggest any future work done in this area to utilize a framework, such as the one we have proposed, to achieve a comprehensive understanding of this complicated topic.

We can conclude from this review that the choice of mastectomy versus BCT is a complicated decision-making process and influenced by many factors. When reviewing ESBC procedure rates, administrators should consider the complexity behind treatment choice. Instead of focusing on mastectomy rates as a quality of care indicator, there should be a shift in attention to whether patient-centered care and SDM are being achieved. Care

teams should ensure patients are making treatment decisions based on informed personal preferences and values. Additionally, future research can be aimed to identify barriers to appropriate care, such as long travel times and lack of lodging for radiation treatments.

List of abbreviations

BCT – Breast conservation therapy

CASP – Critical Appraisal Skills Programme

DCIS – Ductal carcinoma in situ

ESBC – Early stage breast cancer

NIH – National Institute of Health

NOS – Newcastle-Ottawa Scale

PICO – Population, intervention, comparison, outcome

PRESS – Peer review of electronic search strategies

PRISMA – Preferred reporting items for systematic reviews and meta-analyses guidelines

SES – Socioeconomic status

SDM – Shared decision-making

3.9 Declarations

Conflicts of Interest: None

Acknowledgements – We would like to thank Dr. Pamela Meiers for her advice regarding our inclusion criteria of studies and in article screening. We would like to thank Vicky Duncan for peer reviewing our search strategy. We would like to thank Dr. Kesiena Akpoigbe for his help in data collection and assessment of bias for the quantitative articles.

CHAPTER 4: METHODS

4.1 Exploratory Sequential Mixed Methods Design

Many definitions of mixed methods are available in the literature; one such definition is ‘research in which investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry’.(90) (p.4) In 2011, the National Institutes of Health (NIH) commissioned a report on ‘Best Practices for Mixed Methods Research in Health Sciences’ to assist investigators in using mixed methods and aiding reviewers in evaluating it.(91,92) They describe what are commonly accepted as the four major mixed method specific designs: convergent (parallel or concurrent) design, sequential designs (explanatory sequential or exploratory sequential), embedded (nested) designs, and multiphase design.(92) This program of research followed the classical description of an exploratory sequential mixed methods design. This research was conducted in two phases beginning with an initial exploratory qualitative phase followed by a second phase of quantitative data collection and analysis that builds on the results of the first qualitative phase.(93)

4.1.1 Rationale Behind Mixed Methods Design

This program of research has employed mixed methods research for multiple reasons. The most important reason was choosing a research design that best fit the research aims. Decision-making around ESBC therapy is complicated and we sought to create a study design that best investigated the full extent of factors influencing therapy choice while still capturing a maximal proportion of the study population. We felt using a

combination of qualitative and quantitative approaches enabled us to better understand our research query rather than utilizing any single approach alone.(94) By utilizing qualitative methods initially, we were able to investigate in depth connections underlying patients therapy choice. By using quantitative methods subsequently, we were able to directly apply what was learned in the initial qualitative phase of research, as well as from other literature, to more broadly study the Saskatchewan population and obtain results that are more generalizable.

A primary goal of employing an exploratory sequential design is to use the initial qualitative results to help inform and improve the quantitative study.(94) This is often to help develop an instrument based on the results.(93) These goals are directly in-line with our own research goals. As little was known about Saskatchewan's local practice patterns and patient preference factors in ESBC, an initial qualitative study greatly improved our ability to design a pertinent survey. The qualitative study was aimed at identifying the factors that influenced patients' choice within our population of interest, Saskatchewan women with ESBC. These findings directly guided creation of the portion of our questionnaire aimed at capturing individual preferences and values. As the questions were grounded in Saskatchewan patients' perspectives, specific questions, terminology, wording, and follow-up questions were based on our initial qualitative study. For example, if a participant rated worry about cancer recurrence as an important factor influencing her choice of therapy, she was asked a follow-up question to identify the secondary reason that impacted this worry about recurrence. This depth in questionnaire design and the specific response options were created based on findings from our initial qualitative study.

We are able to compare and contrast the results of the exploratory qualitative thematic findings with those from the quantitative survey. If findings from both studies and data sources are congruent, the conclusions drawn will be stronger and more contextualized. If some results are contrasting, this may point to areas needing further investigation in future research. Reporting and drawing results from two intersecting studies will also more readily bridge the gap of understanding between research and practice.

Another reason to choose an exploratory sequential design is if there are no guiding frameworks in place.(93,94) There were previously no guiding framework on understanding the factors that influence a woman's choice between mastectomy versus BCT in ESBC. Most of the past research on this topic has been clinically based and not theoretically driven. As this topic is complicated and multifaceted, an initial qualitative exploration enabled the research team to use their results, in combination with other resources, to create a conceptual framework (see chapter 7).(95) This framework was important in guiding design and creation of the survey in the following quantitative phase of research.

4.2 Initial Qualitative Phase

4.2.1 Interpretive Description

The methodological approach for the qualitative study is interpretive description (ID). ID is a qualitative framework originating from the nursing field, first introduced by Sally Thorne and colleagues in 1997.(96) ID arose from a need for an applied qualitative research approach that better aligned to complex clinical phenomena within applied health disciplines.(97) As described by Thorne (2008), 'Interpretive description is a qualitative

research approach that requires an integrity of purpose deriving from two sources: (1) an actual practice goal, and (2) an understanding of what we do and don't know on the basis of available empirical evidence (from all sources)'.(97) It is not a prescribed set of steps to perform in a study, but rather a design logic model whereby qualitative studies that are generally performed in applied disciplines can be designed and enacted with meaningful results. ID can serve as a framework for which various data collection and analytic strategies can be used, depending on the study query, as long as there is consistency and logic between methods and intent of study.

The epistemological foundation of ID aligns closely with naturalistic inquiry, acknowledging the constructed and contextual nature of human experience that at the same time allows for shared realities.(98) Thorne elaborates on the philosophical underpinnings and assumptions about knowledge in her book(97):

- Are conducted in as naturalistic a context as possible in a manner that is respectful of the comfort and ethical rights of all participants
- Explicitly attend to the value of subjective and experiential knowledge as one of the fundamental sources of clinical insight
- Capitalize on human commonalities as well as individual expressions of variance within a shared focus of interest
- Reflect issues that are not bounded by time and context, but attend carefully to the time and context within which the current expressions are enacted
- Acknowledge a socially 'constructed' element to human experience that cannot be meaningfully separated from its essential nature
- Recognize that, in the world of human experience, 'reality' involves multiple constructed realities that may well be contradictory, and
- Acknowledge an inseparable relationship between the knower and the known, such that the inquirer and the 'object' of that inquiry interact to influence one another
- *A priori* theory cannot encompass multiple realities that are encountered; rather, they recognize that theory must emerge from or be grounded in that phenomenon

In this way, these philosophical underpinnings provide a foundation of coherence for ID studies and separate them from other blended approaches or generic qualitative description.

ID stresses the value of building inquiries within existing knowledge so findings can be constructed on the work of others, calling it 'theoretical scaffolding' (97) similar to what is described as an 'analytic framework' in the literature. (96) Establishing a foundational forestructure has two critical elements to create an appropriate platform on which to build a qualitative design. The first element is the review of the literature; this is to ground the study within existing knowledge and draw conclusions about what is known in relation to the clinical problem that concerns the investigator. This is an opportunity to critically reflect on what exists and does not and offer commentary on the overall body of knowledge. The second element is theoretical forestructure, which refers to recognizing the researchers own orientation and theoretical ideas that they bring from their discipline. Expert clinical knowledge is seen as solid grounding for research design, especially in areas where empirical data about a phenomenon are limited. Expert clinical knowledge can provide relevant structure and orientation for initiating an inquiry. As this is explicitly done as a foundation of the inquiry, it will typically be challenged as the inductive analysis proceeds. This also provides a basis upon which the design logic and the inductive reasoning in interpreting meanings with the data can be judged. (96)

ID promotes the use of purposeful sampling and theoretical sampling, reflecting awareness of expected and emerging variations within the phenomenon of study. (98) Multiple data sources and triangulation are also encouraged. A collateral data source that is also discussed by Thorne is the 'thoughtful clinician', whose perspectives will have been

formulated based on seeing large numbers of cases, each with their own potential variations and diversities. The 'thoughtful clinician test' may be built into the study design to help avoid analytic errors as well. This triangulation technique with other participant data can improve the power of study findings.(97) Data analysis is not restricted to one method, but instead promotes interpretation of data while exploring meanings and explanations that may yield clinical implications. General techniques such as concurrent data collection and analysis, constant comparative analysis, and iterative analysis are suggested.(98) There are several limitations to the use of ID as a methodological framework. One of the primary challenges is the relative novelty of this method. Although texts describing the method are thorough, its implementation in study designs throughout the literature is limited. Therefore, there are few resources that can be referred to for further guidance and examples.

The choice of ID as a framework to examine why Saskatchewan women choose mastectomy versus BCT was a natural fit. Not only does the philosophical basis align with the perspective of the researcher, the framework provides excellent congruency between intended research design, methodology, objectives and methods in the project. As the study objectives and applications are clinically grounded, ID provides a methodology that best orients the research process towards the clinical context and the generation of practice-relevant findings. This fits well with the overall sequential mixed methodology study as well. Furthermore, the clinical expertise of the researchers involved in this study provide an excellent basis for theoretical forestructure, as well as a clinical basis for interpretation. Despite being a relatively new qualitative approach, expert qualitative researchers such as Margaret Sandelowski strongly support this method: 'Indeed Thorne is to be commended

for acknowledging and celebrating accommodations of method to research imperatives and disciplinary agendas of the scholars using them'.(97)

4.2.2 Thematic Analysis

The method of analysis chosen for this study is thematic analysis, as described by Braun and Clark (2006).(99) This method has a clearly outlined process, application, guideline to use, and evaluation. This method is specifically outlined into six steps: (1) familiarizing yourself with your data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes (5) defining and naming themes (6) producing the report.(99) These steps are each described in greater detail below. General qualitative research strategies like constant note writing, recursive processing, and simply taking time to examine and think about the data, are emphasized throughout all steps. It is important to note that although the analysis is outlined in a linear phase-by-phase process, thematic analysis is more realistically conducted as a fluid and recursive process.(99,100)

The initial familiarization phase should have the researcher become familiar with all aspects of the data. This can be achieved through many means: participating in data collection, active reading and re-reading for meanings and patterns, orthographic transcription of data, and taking notes. Reading the data should be done in an 'active way – searching for meanings, patterns and so on'.(99) Immersion into the data should be to the extent that the researcher is familiar with the depth and breadth of the content. It is recommended to start making notes and formulate some overall ideas for coding in the subsequent phase.

The second phase is generalizing an initial set of codes from the data. The process of coding is considered part of the analysis, as the data are organized into meaningful groups.

Coding can be performed in a data-driven/inductive way or theoretical/deductive way.

Inductive or bottom up analysis creates codes close to the data, without trying to fit them into pre-existing coding frames or the researchers' analytic preconceptions. Deductive or top down analysis is generally more explicitly theoretically or analyst driven, and often driven more specifically by the research question. The entire data set should be analyzed systematically, paying full and equal attention to each data item to identify interesting aspects in the data set. These codes will form the basis of repeated patterns (themes) across the data set. A comprehensive and inclusive approach should be taken for the initial coding phase.

The next phase is searching for themes. This involves sorting the different codes into potential themes and collating the relevant data extracts from within the identified themes. Organization of themes may be done with a variety of methods including: tables, mind-maps, theme-piles, and/or thematic maps. This phase involves further analysis of codes, as the researcher is considering how different codes may combine to form themes. A candidate or initial thematic map is encouraged as this promotes thinking about the relationship between codes, between themes, and between different levels of themes.

The fourth phase is reviewing the themes. This process of refining and reviewing themes is a two-stage process. The first is reviewing themes at the level of individual coded data extracts to see if they fit into the candidate themes. All collated codes need to be re-read for each theme to consider fit and whether they appear in a coherent pattern. Codes may need to be redirected to different themes, or candidate themes themselves may need to be collapsed, expanded, combined, or discarded. The second phase is reviewing the validity of individual themes relative to how they fit to the entire data set. The researchers'

theoretical approach may influence how this review step is conducted. The candidate or re-worked thematic map is reviewed for how accurately it reflects the meanings of the data set as a whole. Coding additional data within the reworked themes is also encouraged, and often done as an ongoing process. This phase can also be conceptualized as examining for 'internal homogeneity' and 'external heterogeneity'. This phase may be an iterative process until the researcher is satisfied with the fit of the themes and thematic map with the overall data set.

The fifth phase is defining and naming themes. Defining a theme is meant to identify the 'essence' of what each theme is about. This explanation should include what scope and aspect of the data set each theme captures and what it does not. Final data extracts for each theme can be collated, organized, and be given a consistent account with narrative. It is important to go beyond summarizing or paraphrasing in order to identify the interesting features of theme, with supporting evidence. This detailed analysis should also consider how the theme fits into the broader overall story relative to the research questions or objectives. Identified subthemes can be similarly defined and explained at this stage. By the end of the stage, final names for each theme should be given for final analysis.

The sixth and final phase is producing the actual report. This may be for the purpose of publication, an assignment, or dissertation. Whatever the end goal, the report should convince the reader of the merit and validity of the analysis. Braun and Clarke emphasize the importance that the analysis 'provides a concise, coherent, logical, non-repetitive and interesting account of the story the data tell – within and across themes'.(99) Data extracts should be used to exemplify the essence of the themes. Interpretive claims may be related

to existing literature. The overall analytic narrative should go beyond description to make an argument in relation to the research question.

Initial familiarization with the data included reviewing all transcripts of the interviews to become submerged in the data. Subsequently three members of the research team, two of the interviewers and one qualitative expert (J.G., Y.H., A.L.), individually created an initial set of codes using sample interviews transcripts. The team met on multiple occasions to discuss the initial candidate codes. When appropriate, in vivo codes were created by using participants' language as labels. These codes were then sorted to create, modify, and complete an initial thematic index. Throughout this process, there was emphasis on being comprehensive and inclusive of coded data.

Subsequent analysis was completed by JG. In-depth, line by line coding utilizing the initial thematic index was conducted for all interviews. Coding and modification of the thematic index was an iterative process (Appendix D). Once completed, an initial candidate thematic map was created using the TPB as a guiding framework (Appendices E and F). Separate maps were created for the mastectomy and BCT data sets.

All codes and themes were reviewed in the next stage of analysis. All coded data extracts for a theme were individually reviewed and refined to ensure they formed a coherent pattern. Any co-existing codes within a data extract had codes and originating themes compared for associations. This process was conducted through all candidate themes. Individual themes were subsequently reviewed in relation to other themes, the concept map, as well as the data set as a whole. Re-working the codes, themes, and concepts maps was an iterative process. Constant-comparison techniques were utilized to confirm and challenge ideas throughout themes.(98) This was done in both the mastectomy and

BCT analysis, producing final thematic maps and results (Figure 5.1 + 5.2). To increase the validity of findings, the 'thoughtful clinician' test as described by Thorne was employed.(98) Expert clinicians with surgical oncology or breast fellowships, familiar with the decision-making process, were consulted to review study results to see the extent to which they match or enlarge their clinical hunches. The findings were shared with clinicians, encouraging them to challenge or confirm the evolving interpretations. Member checking with patients was not performed due to time constraints.

Thematic analysis was chosen because this method allows for the theoretical flexibility to be tailored to both interpretive description and applied research. In contrast to many other analytic methods, thematic analysis is not wed to any pre-existing theoretical framework and is not a full research methodology on its own. 'What is important is that the theoretical framework and methods match what the researcher wants to know'.(99) Combining this flexibility with interpretive description as a qualitative approach provides an opportunity for congruency throughout the analytic process. Thematic analysis allows for the use of theoretical forestructure, both from the literature and clinical expertise, to be incorporated into the analysis. The applied research goals of interpretive description and thematic analysis are both appreciated. Despite the flexibility of thematic analysis, rigorous research can be achieved through clear and explicit explanation of analysis. Reicher and Taylor (2005) state that 'rigour lies in devising a systematic method whose assumptions are congruent with the way one conceptualizes the subject matter'.(99) Furthermore, this is a relatively easy method to learn, making it ideal for a novice qualitative researcher.

There are several potential limitations of thematic analysis. Although flexibility of the method is an advantage, this does leave opportunity for a range of potential problems

throughout the analysis. As there is potential variability on how data are analyzed, specific guidelines for higher-level analysis is limited. Furthermore, if thematic analysis is not linked to an existing theoretical framework, its analytic and interpretive power is limited beyond description. Because novice qualitative researchers often use thematic analysis, its methods can be misused by not following proper methods and qualitative research principles. This has led to thematic analysis sometimes appearing as a generic qualitative analysis.

4.2.3 Remaining Qualitative Study Details

An interview guide can be seen in Appendix G. Remaining qualitative study details including: recruitment/instrumentation, analysis, mastectomy participant result, BCT participant results, discussions, limitations, and conclusions are detailed in the published journal article in Chapter 5.

CHAPTER 5, MANUSCRIPT #2: UNDERSTANDING WOMEN’S CHOICE OF MASTECTOMY VERSUS BREAST CONSERVING THERAPY IN EARLY STAGE BREAST CANCER

5.1 Article Citation:

Gu J, Groot G, Holtslander L, Engler-Stringer R. Understanding Women’s Choice of Mastectomy Versus Breast Conserving Therapy in Early-Stage Breast Cancer. Clin Med Insights Oncol. 2017 23;11(10):1179554917691266.

Content included in this article does not significantly differ from the published manuscript. However, grammatical modifications have been made, and the document has been reformatted from the original version for inclusion in this thesis.

5.2 Abstract

Objective: To identify factors that influence Saskatchewan women's choice between breast conservation therapy (BCT) or mastectomy in early stage breast cancer (ESBC) and to compare and contrast underlying reasons behind choice of BCT versus mastectomy.

Methods: Interpretive description methods guided this practice-based, qualitative study.

Data were analyzed using thematic analysis and presented in thematic maps.

Results: Women chose mastectomy consistent with one of three main themes: worry about cancer recurrence, perceived consequences of BCT treatment, or breast-tumor size perception. In contrast, women chose BCT consistent with one of three different themes: mastectomy being too radical, surgeon influence, and feminine identity.

Conclusions: Although individual reasons for choosing mastectomy versus BCT have been discussed in the literature, the different rationales underlying each choice have not been previously described. These results are novel in identifying interdependent subthemes and secondary reasons for each choice. This is important for gaining increased understanding of factors that influence a complicated decision-making process.

5.3 Keywords

Cancer, Oncology, Decision-Making, Breast Conservation Therapy, Mastectomy, Early Stage Breast Cancer

5.4 Introduction

In North America, breast cancer is the most commonly diagnosed cancer and the second most common cause of cancer death for women.(11) For early stage breast cancer (ESBC), it is well established that breast conservation therapy (BCT) and mastectomy offer equivalent survival.(2–4,101) Treatment for ESBC can therefore be viewed as preference sensitive care, so that decision-making between treatment options should vary according to patient preferences and values, although it could also vary for other reasons.(32)

Quantitative studies have examined the factors that influence therapy choice, but this literature is limited to mostly chart or database reviews, is largely retrospective, and has been conducted mostly outside of Canada.(13–15) Common demographic factors examined in such studies include age, education, and ethnicity. Age has shown discrepant results, with the most consistent finding being an increased likelihood of undergoing mastectomy in those younger than 40 or 50.(13) The middle age groups generally do not show significant findings. Age groups older than 70 or 80 have shown mixed results, with some studies noting increased mastectomy rates but others showing decreased rates.(16,26) Furthermore, some studies have not found any association of age with mastectomy rates.(47,102) With respect to ethnicity, African American, Hispanic, and Asian / Pacific Islander women have independently been associated with increased rates of mastectomy.(13,74)

Travel-related factors such as distance to a radiation treatment centre have shown varying effects on rates of BCT versus mastectomy. Although several studies have demonstrated a decreasing rate of BCT as distance to radiation centre increases(62,69,70), others have found no difference.(75,103)

Individual values and preferences may be the most important subset of factors influencing choice of mastectomy versus BCT, yet are the least well studied. The complex nature of decision-making in ESBC makes fully understanding the spectrum and significance of these factors difficult. The majority of this research has been through simple stand-alone questionnaires, or descriptive qualitative studies. Important personal beliefs and preferences previously noted in the literature include equivalent survival between BCT and mastectomy, fear of cancer recurrence, cosmetic appearance, and feminine identity.(16,71,73,76)

Mastectomy rates across Canada have varied greatly over the past decade with the latest reports from 2008 to 2013 showing interprovincial rates ranging from 25.3% to 68.3%.(27) This geographical variation raises many unanswered questions: Are differences related to quality or appropriateness of care? Are attitudes and beliefs of clinicians influencing procedure rates? Are treatment choices related to local patient factors such as belief patterns or geography? This study takes place in the province of Saskatchewan, which had the second highest mastectomy rate of 63.4%, compared with a national average of 39%.(27) To better understand the nature of this variation as well as the factors that informs women's treatment options, further research is needed, beginning with patient decision-making at the regional level . The objective of this study was to identify factors that influence Saskatchewan women's choice between BCT and mastectomy in cases of ESBC, comparing and contrasting the underlying reasons behind that choice.

5.5 Methods

5.5.1 Methodology

The Interpretive Description qualitative methodology was used to guide this research.(26) This methodology is often used in complex clinical phenomena for applied qualitative research within health disciplines such as nursing, psychiatry, and medicine.(96–98,104) The philosophical basis aligns well with the researchers' perspectives, and the framework provides congruency between the methodology, objectives, and methods in this project.(26) The choice between mastectomy and BCT can be viewed as a planned behavior. The Theory of Planned Behavior is a conceptual framework that links beliefs and behavior.(38) This framework, which has been used to study ESBC decision-making in the past(39), and helped guide this study's framework and analysis.

5.5.2 Sampling and Recruitment

REB approval was obtained from the University of Saskatchewan. The Saskatchewan Cancer Agency (SCA) provided recruitment support. Women who had ESBC and who had been treated in the calendar year preceding July 2013, were identified. The SCA recruited participants by mailing letters of invitation to potential participants. A purposeful sampling plan was aimed at capturing diversity and variation in the phenomenon under study – specific characteristics identified included different age groups, minority groups, and urban versus rural location of residence. No incentive was offered for participation. Potential research participants contacted the researchers and face-to-face interviews were arranged at the convenience of the participant, including in rural locations.

Data collection was conducted by the lead author, who is a surgical resident and doctoral student (J.G.), and by two research assistants who were medical students. Supervision was provided by a clinical expert (G.G) and a qualitative expert (A.L.). Interviews for thirteen women who chose mastectomy and twelve women who chose BCT were included for analysis. Two mastectomy and three BCT interviews were excluded because the patients felt that they had not been offered treatment options, and thus had not engaged in a decision-making process. Semi-structured interviews allowed for in-depth open-ended discussions based on questions formed from factors previously known in literature(13,14,66) as well as from other clinically-based hypothesized factors. All interviews were audio-recorded and transcribed verbatim.

5.5.3 Analysis

The ATLAS.t.i. software was used for data management and analysis. Thematic analysis followed Braun and Clark was conducted.(99) Three members of the research team – two interviewers and one qualitative expert (J.G., Y.H., A.L.) – created a set of codes using sample interviews from the primary data. When appropriate, in vivo codes were created by using participant’s language as labels. These codes were then sorted to create, modify, and complete an initial thematic index.

Subsequent analysis was completed by JG. In-depth, line-by-line coding using the initial thematic index was done for all interviews. Coding and modification of the thematic index was an iterative process. After completion, an initial candidate thematic map was created using the Theory of Planned Behavior as a conceptual framework. Separate maps were created for the mastectomy and BCT data sets. Next, all coded data extracts for a theme were individually reviewed and refined to ensure that they formed a coherent

pattern. Individual themes were subsequently reviewed in relation to other themes, the concept map, and the data set as a whole. Re-working the codes, themes, and concepts maps was an iterative process. Constant-comparison techniques were used to confirm and challenge ideas throughout themes.(98) This was done in both the mastectomy and the BCT analysis, producing final results illustrated in thematic maps (Figures 5.1 and 5.2). To increase the validity of findings, the 'thoughtful clinician' test described by Thorne was employed.(98) Expert clinicians with surgical oncology or breast fellowships were asked to review the study results and challenge or confirm them.

Audio recordings, participant transcripts, thematic indexes, concept maps, and early thematic maps are available from the authors upon request.

5.6 Results

5.6.1 Demographics

Thirteen patients who underwent mastectomy and twelve patients who underwent BCT were interviewed. Averages ages and rural versus urban distribution of participants were comparable. Demographic data appear in Table 5.1.

Table 5.1: Demographics

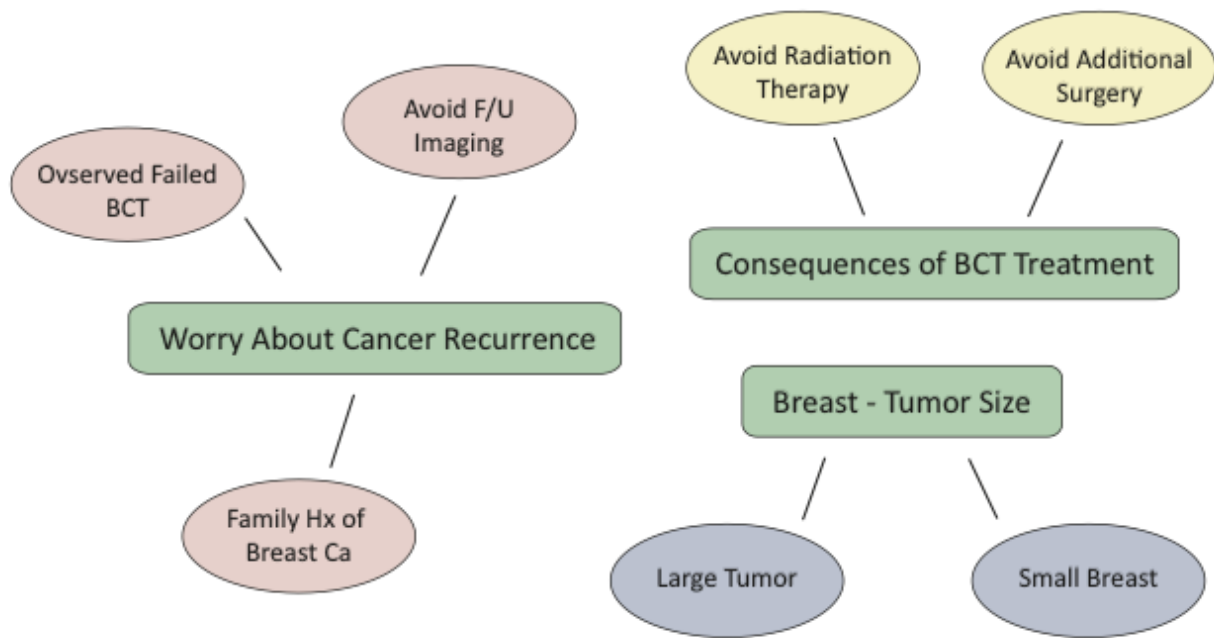
Characteristic	Mastectomy (N)*	BCT (N)*
Median age in years at the time of diagnosis (range)	64 (33-89)	60 (46-80)
Participant's home in a rural location	4 (30.8)	5 (41.7)
Participant's home in an urban location	9 (69.2)	7 (58.3)
Participant's home located in a tertiary centre with a radiation centre	7 (53.8)	6 (58.3)
Participants of a visible minority	1 (7.7)	1 (8.3)

* Number in parentheses refers to percentages unless otherwise specified

5.6.2 Mastectomy

Women who chose mastectomy primarily based their decision on one of three main themes: worry about cancer recurrence, worry about the consequences of BCT treatment, or perception of the breast-to-tumor size ratio. The final thematic map indicating women's reason for choosing mastectomy is shown in Figure 5.1.

Figure 5.1: Thematic Map for Mastectomy Participants



Worry about cancer recurrence. This theme was the main reason most women chose mastectomy. Participants were concerned about cancer recurrence and wished to do everything they could to minimize this risk. This concept formed by combining two earlier themes, minimizing cancer recurrence and obtaining peace of mind. The choice of mastectomy relieved these participants' concerns about breast cancer and was described as 'eliminating risk', 'getting rid of it all', and obtaining 'peace of mind'. This is well exemplified through the following participant response: 'And just eliminating the risk, and I am a worrier, and I would probably always be feeling my breast and think "oh no"' (Mastectomy participant 2). The source of worry about cancer recurrence was always related to another underlying reason, or subtheme: observed failed BCT, avoiding follow-up imaging, and family history.

Observed failed BCT. A common reason for worry about cancer recurrence was having had a close family member or friend fail BCT. Failures were described as requiring re-excisions, having subsequent mastectomy, cancer recurrence, or death from cancer.

These negative experiences in the lives of close individuals caused significant apprehension and deterred participants from believing, trusting, or pursuing BCT.

I had known always, and I've said this for years, but if I ever had breast cancer I would have a mastectomy. I don't believe in lumpectomy, and I don't believe in radiation treatments. I've had many friends who have had lumpectomy in the past and they've all had cancer recurrence. And then had to have more surgery again. So I don't believe in lumpectomy (Mastectomy participant 7).

Avoid follow-up imaging. Some participants did not want the continual follow-up imaging required with BCT. The process of repeated imaging tests checking for recurrence caused fear. Participants felt more comfortable having all of the breast tissue removed, knowing that they would not have to deal with this source of worry. 'I always thought I would always get it all taken care at once. The risk of recurrence, and the fear finding a lump again, and the fear of always checking, I would always be looking for a lump and I didn't want that' (Mastectomy participant 3).

Family history. A strong family history influenced two participants' decisions to choose mastectomy. This increased worry about recurrence was evident when a 68-year-old participant said: 'Even if it was a lumpectomy today, what is the chances I might not get it again... The guiding factor was my strong family history of breast cancer' (Mastectomy participant 13).

Consequences of BCT Treatment. Some participants held firm opinions that choosing BCT would result in consequences that they did not wish to experience. These were either side effects of radiation therapy or the potential of requiring more surgery. Avoidance of radiation was based on individuals' having observed adverse side effects afflicting someone

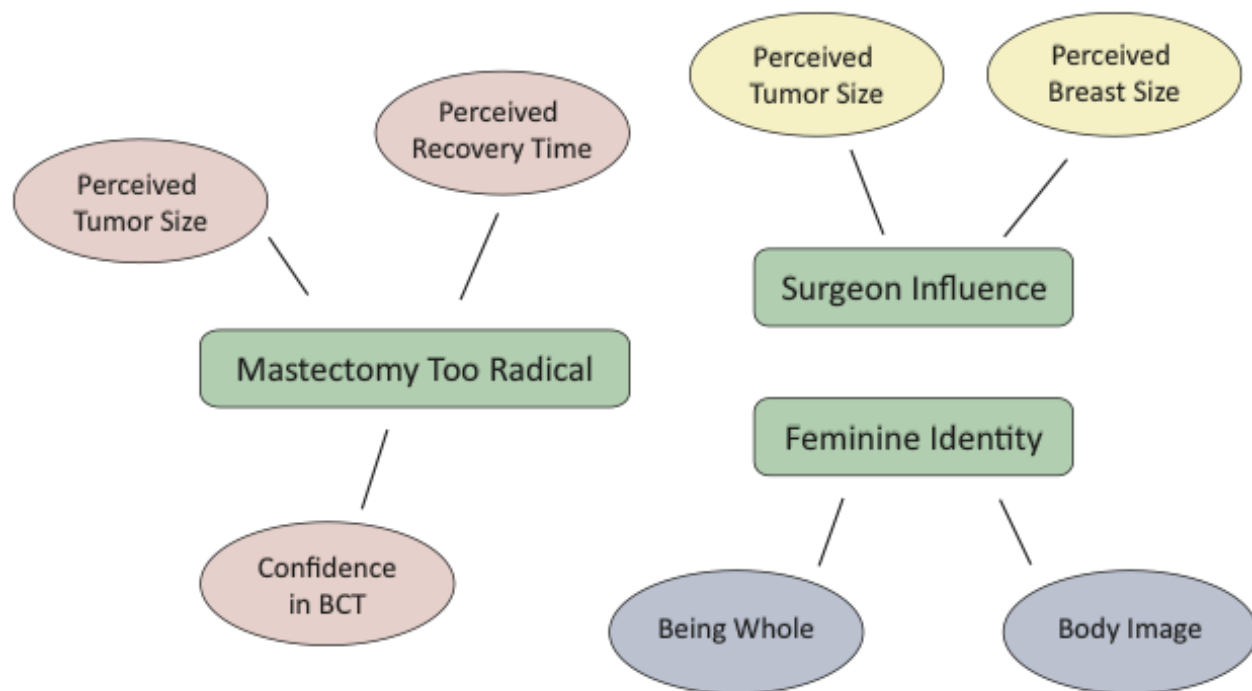
they knew, or from workplace experiences: 'I didn't like the idea of radiation, I work in the OR and I've seen surgeons complain of radiated fields so I did not want to have radiation. So that's the reason I chose mastectomy' (Mastectomy participant 13). Some participants wanted to undergo surgery only once, without risking re-operation. Although wanting to avoid radiation and re-operation risk were often related, only one was central in the decision to have mastectomy.

Breast-Tumor Size. The size in this theme refers to what was perceived by the participant throughout her treatment interactions. The perceptions of having a large tumor, small breast, or large tumor-breast ratio were important influences in the choice of mastectomy. 'I remember in my mind lumpectomy was never an option. I never was considering it. Because of the size of the tumor I just wanted the whole breast gone. And with lumpectomy I wouldn't have been left with very much breast tissue anyways' (Mastectomy participant 8).

5.6.3 Breast Conservation Therapy

The central themes that influenced women to choose BCT were: mastectomy being too radical, surgeon influence, and feminine identity. The final thematic map illustrating why women chose BCT is shown in Figure 5.2.

Figure 5.2: Thematic Map for BCT Participants



Mastectomy Too Radical. Having the entire breast removed with a mastectomy was viewed as being too radical or extreme for the stage of disease patients' felt they had. Mastectomy being too radical was related to some main subthemes: perceived recovery time, perceived tumor size, and confidence in BCT.

Perceived recovery time. The subjective difference in the impact of operation between mastectomy versus BCT surgery influenced women's decision making. Participants choosing BCT wanted surgery that put less stress on the body, had a shorter recovery time, and had less overall effect on their life. This was sometimes due to participant's older age or the presence of comorbid disease.

I wanted the one that took less time, had less impact on my life. I think the mastectomy would have taken more time to recover. A friend of mine has gone through it, she is still off of work and it has been almost three years. She has gone through a lot of struggles and physiotherapy and I felt lucky that we caught it early and I didn't have to deal with that part (BCT participant 12).

Perceived tumor size. A central reason behind many women's decision for BCT was that mastectomy was viewed as too radical considering to the size of the tumor. Several participants felt that they didn't need a drastic surgery to control a small tumor. 'Because it had been so small, if it was massive I would say, "Look, let's do something major". It was so small – why should I lose a whole breast?' (BCT participant 06).

Confidence in BCT. Several women explicitly expressed confidence in BCT treatment and were comfortable with the potential consequences of this approach. Furthermore, they acknowledged the possibility of a further surgery, preferring a 'staged approach':

I think because there is less complications if I go that way. Also I have a second chance to go that way if I have to. I have a firm belief that science has come so far over the years. Those things were encouraging for me (BCT participant 11).

Surgeon Influence. Surgeon influence was a common reason for women's choice of BCT. The surgeon was held as an important referent whose opinion was highly valued. In fact, several women completely defaulted their treatment decision to their surgeon's recommendation. These women expressed strong trust and faith in their surgeon.

And of course he influenced it – he knows more about the area than I do. And when he said if it was his mother he would recommend the lumpectomy ... even though you are a retired health care provider its different when you are on the other side of the fence. You don't think logically. It was mostly his recommendation to have the lumpectomy (BCT participant 5).

Often the recommendation for BCT was due to the perceived small size of the tumor from the surgeon's perspective. This idea was repeatedly cited by participants: 'Whatever the

surgeon recommended I was willing to do.... after she explained to me how small the tumor was and the treatment available I didn't even have to think about it' (BCT participant 12).

Feminine Identity. Feminine identity encompassed the ideas of self-esteem related to body image, retaining one's own breast, and feeling whole as a woman. Participants felt that breasts were an important part of their body image, which impacted their individual and feminine identity. Furthermore, women explained that breasts are an important part of their feminine identity, and keeping them was central to feeling whole as a person. 'It is really important for me to maintain that female body form. So the image for me was huge, for my self esteem' (BCT Participant 3).

5.7 Discussion

The aim of this study was to explore the decision-making of women in Saskatchewan who had early stage breast cancer, identifying key themes underlying the choice of mastectomy or BCT. The main themes identified by the two treatment groups were different, suggesting that women chose to undertake mastectomy or BCT for different reasons. Although the individual reasons identified in this study have been seen in previous literature(17,39,85), choice of mastectomy or BCT has not previously been described as having completely different reasons underlying each choice of therapy. Furthermore, the subthemes or secondary reasons for each choice are also novel observations in this study. The thematic maps created are useful tools for providing visual depictions of decision-making factors for patients and health care workers.

Fear and worry about cancer recurrence has been found in the literature to be an important reason behind women's choosing mastectomy(17,85) and often also the most influential factor for treatment decision-making.(16,39,73) This study confirmed the significance of worry, as well as that these feelings' relation to an additional underlying reason: having observed failed BCT, wishing to avoid follow-up imaging, or family history. A secondary level of connection has never before been identified in the breast cancer literature and would be an important area of further exploration. The most common subtheme was related to the negative BCT or positive mastectomy experience of a close family member or friend who had ESBC, which influenced choice. This has been known to affect decision-making and cancer risk assessment for patients in the past; other studies have suggested that patients make choices based on experiential interpretation instead of on statistical probabilities.(75,85) Despite clinicians' explanations of equivalent survival,

the subjectively perceived risk of each treatment option often supersedes the objective information given.(105) A plausible explanation for this theme's prominence in this study is that Saskatchewan has many smaller communities, both urban and rural, which may contribute to greater communication between residents about cancer experiences. This is an area that requires further research.

Smaller breast and larger tumor size are well-known factors that increase the likelihood of undergoing mastectomy.(62,66) This study confirms these findings qualitatively and increases the depth of understanding of previously observed data. Two participants felt that BCT was never an option owing to their perceived breast or tumor size, and were thus excluded from the study. This is likely explained because a large tumor to breast ratio is a relative contra-indication to BCT.(19)

A proportion of women chose mastectomy to avoid consequences of BCT treatment: length of treatment required for radiation, side effects specific to radiation, and risk of re-excision as a result of positive margin. Other studies have identified similar trends.(71,75) These may be due to poor communication or understanding of side effects specific to breast radiation. Further investigations into these specific factors are required.

Mastectomy being considered too radical was an important reason women chose BCT in this study; choice was related to recovery time from surgery, perceived tumor size, and confidence in the BCT approach. Choosing BCT as a way of avoiding extensive surgery has been previously discussed in the literature, especially for older age groups.(16,106) Prior studies using surveys have commonly reported equivalent survival between BCT and mastectomy as a main reason for choosing BCT, listing 'equivalent survival' as a selection item.(16,71) In contrast, our study used open-ended questions, which resulted in

mastectomy being too radical as the emerging central theme. These results suggest that not only the knowledge that survival between treatments is equal but also the early stage of disease causes mastectomy to be viewed as an extreme treatment option. A perception that the tumor was small also influenced patient's views that mastectomy was radical. Although quantitative data have consistently associated smaller tumor size with higher BCT rates(13–15), this study provides an explanation behind this finding.

The literature varies on whether distance to radiation centre affects rates of BCT. Although several studies show a decreasing rate of BCT as distance to radiation centre increases,(69) numerous studies that show no difference.(70,75,103) Despite Saskatchewan's large rural population, this study did not find that travel distance to a radiation treatment centre deterred participants from choosing BCT. Regional investigation on a larger scale may be important to confirm this finding.

Surgeon influence was a primary reason underlying many women's choice of BCT. Those who had difficulty choosing between therapies would often default to the surgeon's recommendation. Literature has previously shown surgeon influence and recommendations to be an important factor in treatment decision-making.(16,39,107) A unique finding in this study, differing from previous literature, was that surgeon influence was an important theme underlying women's choice of BCT but not choice of mastectomy. This is an important distinction that should be considered for future research.

The theme of feminine identity was an important reason many women chose BCT. In our study, this theme encompassed the ideas of body image, feeling whole as a female, and keeping one's own breast tissue. The influences of these ideas have previously been individually identified as important factors influencing women's choice of BCT.(39,71,73)

5.8 Limitations

This study was retrospective, which presents potential limitations that include recall bias and post-treatment experiences. It is possible that patients reported their decisions based on post-hoc justification instead of citing the reasons that were important at the time of decision-making. Patients were recruited based on chart review clinical criteria for ESBC. However, whether explicit choice of therapy was offered or memory lapsed during the encounter was unclear in some circumstances, which may have led to unnecessary exclusion from this study. Other studies have identified that patient recall of events surrounding cancer diagnosis may be problematic.(108,109) Moreover, the type, amount, and style of information presented from physicians may have varied. Our sampling plan included diversity in minority groups, but unfortunately this was not achieved due to lack of recruitment response. A targeted recruitment strategy may be required in future studies to capture these groups.

5.9 Implications for Practice and Research

This paper has added to understandings of reasons behind choice of therapy for women who have ESBC. These insights, along with the thematic maps, can help guide clinicians and allied health care workers counsel and care for patients who are going through this complicated decision-making process. Some of the novel findings including separate reasons for choosing mastectomy versus BCT, should be further explored in future research. The generalizability of these results should be established in larger-scale survey research and in research across different areas of the country.

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Conflicts of Interest / Funding Source

The authors have no conflicts of interest or funding source to disclose.

CHAPTER 6, MANUSCRIPT #3: CREATION OF A NEW CLINICAL FRAMEWORK – WHY WOMEN CHOOSE MASTECTOMY VERSUS BREAST CONSERVING THERAPY

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Content included in this article does not significantly differ from the published manuscript. However, grammatical modifications have been made, and the document has been reformatted from the original version for inclusion in this thesis.

6.4 Background

6.4.1 Introduction

Frameworks have been incorporated in research among many fields, such as population health, public health, and education. However, clinical medicine has lagged in understanding utilizing frameworks and using them to guide research. As a result, research has at times been incomplete, redundant, and less effective in drawing conclusions. Furthermore, in the current research environment, establishing methods to increase understanding between disciplines is critical. This article will highlight the importance of using a conceptual framework to guide clinical research, describing how doing so can improve the research process and giving an example of creating a new framework to examine why women choose mastectomy versus breast conserving therapy (BCT).

6.4.2 What Is a Conceptual Framework?

Carpiano and Daley define a conceptual framework as a set of variables and the relations among them that are presumed to account for a set of phenomena.(110) This can range in scope from a modest set of variables to the capturing of complicated phenomenon such as the WHO conceptual framework for action on determinants of health.(111) Although frameworks set the stage for a scientific inquiry, they do not provide direct explanations for exact outcomes. Understanding a framework's role in research is often done alongside theory and a model, each of which declines in scope but increases in specificity. Briefly, theory can be broadly thought of as the 'draft' explanation for why a phenomenon is observed, such as for why some women choose BCT but others do not. A model is a tool used to make specific assumptions about a limited set of parameters and variables that can be tested.(110)

A framework has multiple purposes, the most important of which is to help understand the phenomenon of interest in a more complete fashion.(110) It should identify all the important constructs of a problem and organize them sensibly in a way that can be readily explained. More than one conceptual framework may be relevant to a situation, but often a framework is designed to capture a specific lens or view of an inquiry.(112) It is important to understand the lens and scope for which a framework was created, as well as how it might be optimally used, before adopting it for one's own research purposes. The latter half of this article gives an example of this process.

Use of a well-constructed framework allows the rest of the research process to follow a coherent structure. A conceptual frame can start by defining the scope of the literature review and can aid in its organization. It will assist in variable selection within each construct to be measured, and it will guide analysis by allowing researchers to structure their inquiry and interpret their results based on theory and relationships between different constructs. Based on the results, researchers are better able to fit their conclusions and add knowledge within the larger context of the overarching framework. One of a framework's most important purposes is that of highlighting and communicating the ways in which the researcher has chosen to define and structure the phenomenon under study. This can be especially important in aligning disciplines within the context of multi-disciplinary research.

Why, then, has so much clinical research not been grounded in theory or based on a framework? To start, many clinicians are not familiar with conceptual frameworks unless they have completed graduate studies. Of those that have come across the term, many do not understand the full scope and purpose of a framework. Furthermore, clinical research

in medicine often follows a course that fails to identify and implement a guiding framework. A clinician may notice something in practice or read a report that inspires a clinical question, then conduct a literature search to identify major relevant works that have been published and a review of existing data on the research query. During this process, the researchers might come across a framework or theory that other researchers have used, but these are rare in clinical journals, as authors will use a traditional literature review to set the stage for their research without considering a framework. When there is no precedent for establishing a framework prior to commencing research, the cycle continues.

In an attempt to capture a holistic snapshot of the existing literature, many researchers will look to a review of the literature, or a systematic review. However, even these are often not based on a framework and may be missing important aspects of a research query. For example, the only published literature review evaluating why women choose mastectomy compared with BCT was by Macbride et al. in 2013.⁽¹³⁾ They synthesized the literature and identified a number of potential factors, including patient sociodemographic factors, race and ethnicity, geographical factors, role of the surgeon, role of reconstruction, decision aids, and influence of BRCA mutation gene.⁽¹³⁾ However, despite this being a review article, they did not integrate literature covering key components of this decision-making process, including individual patient preference factors and clinicopathological factors such as tumor size. This review did not rely on a conceptual framework to guide their work or the synthesis of the literature, which may have played a role in the absence of important factors.

6.4.3 Breast Cancer in Canada

In North America, breast cancer is the most commonly diagnosed cancer and the second most common cause of cancer related death for women.(1) Landmark trials have established that BCT and mastectomy offer equivalent survival rates and can be viewed as equivalent treatments in early stage breast cancer (ESBC).(2–4,101) Treatment for ESBC can therefore be viewed as preference-sensitive care, with decision-making between treatment options varying according to patient preferences and values, though possibly also for other reasons.(32) However, in 1999 the seminal National Institute of Health Consensus Conference recommended BCT as ‘preferable’ (10), prompting ongoing questions about research into quality of care as it relates to regional variation in treatment of ESBC.(45,69)

Significant variations in mastectomy rates among regions has resulted in a large body of literature exploring the various factors influencing women’s choice of mastectomy versus BCT.(46,47) For example, Canada has great interprovincial variation in mastectomy rates, ranging from 26% to 69%.(12) Unfortunately the cause of these variations is poorly understood and has gone largely unexplained, primarily owing to the absence of a framework that can appropriately guide the research question.(12,27) How do researchers integrate political, psychological, biological, and health care system factors into a research project? What about previous literature, individual belief factors, individual life circumstances, the physician-patient interactions, and psychological factors? Exploring these questions and seeking to understand Canada’s regional variation that has led us to designing a framework that can holistically underpin this phenomenon.

6.5 Methods

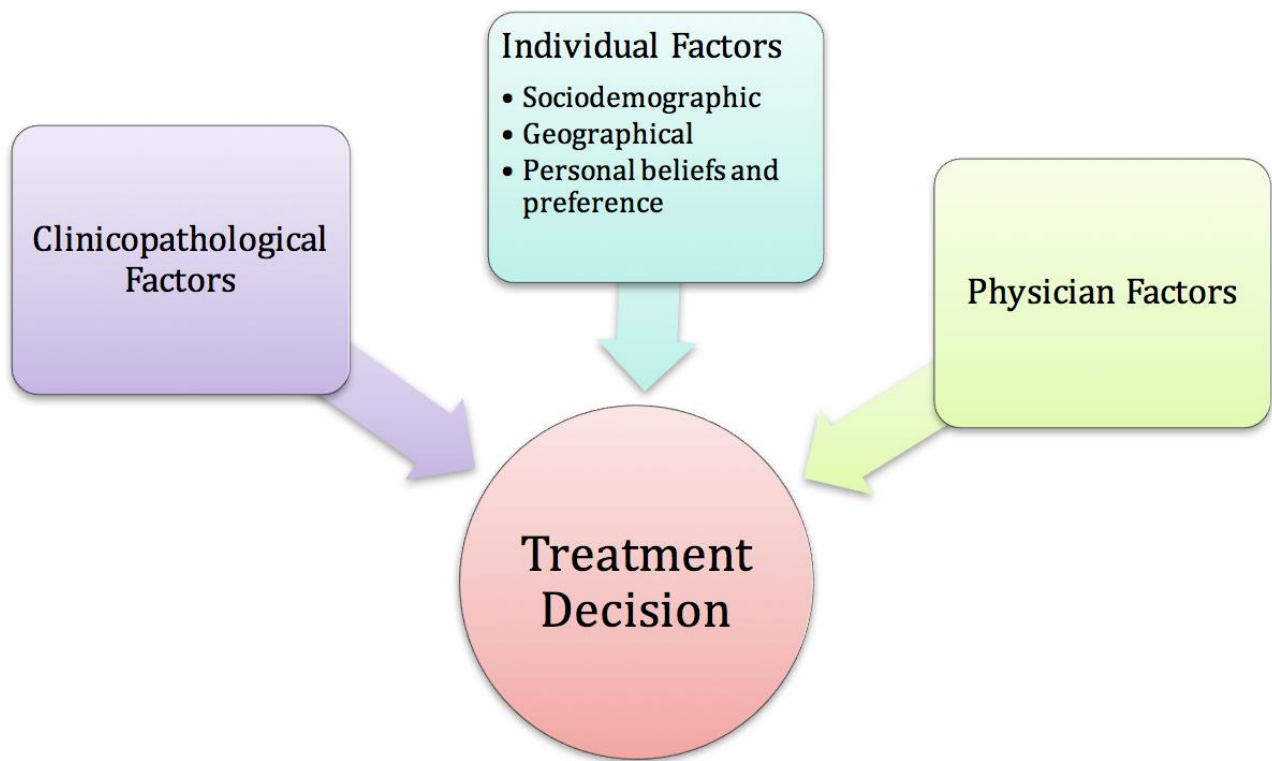
6.5.1 Creating a New Framework – Why Women Choose Mastectomy Versus BCT

The factors that influence a woman's choice of mastectomy or BCT for ESBC are complicated and multifaceted. At present, no guiding framework is available for doing so. Most of the research on this topic has been clinically based, and not theory-driven. Although various frameworks and theories inform individual choice behaviors on a micro scale, as well as shared decision-making between the patient and surgeon at the dyad level, no appropriate framework is available of sufficient scope to holistically underpin our research. The aim of this article is to present a framework of our own devising that can fill this gap in the research. The framework was constructed through integration of previous frameworks, theories, models, literature, and clinical research. In the remainder of this paper, we will introduce our framework and review the key work referenced in creating this framework, highlighting important elements taken into considered.

6.6 Results

We present a conceptual framework of our own devising to illustrate the central domains that influence women's choice between mastectomy and BCT (Figure 6.1). These have been organized into three broad constructs: clinicopathological factors, physician factors, and individual factors with subgroups of sociodemographic, geographic, and individual belief factors. The purpose of this framework is to provide a comprehensive basis for describing, examining, and explaining the factors that influence women's choice of mastectomy versus BCT at the individual level.

Figure 6.1: Conceptual framework illustrating the central constructs influencing women's choice between mastectomy versus BCT



Clinical Literature Supporting Each Construct

6.6.1 Clinicopathological Factors

Clinicopathological factors are placed in an independent domain because they include tumor biological factors over which neither the patient nor the clinician has any direct control, including tumor size, stage, hormone receptor status, and cancer type, and grade. Among these factors, larger tumor size, and thus stage, is most clearly and consistently associated with higher rates of mastectomy.(46,63,67,71) More differentiated tumor grades have also been associated with higher BCT rates.(67) These findings are likely multifactorial in reason, with effects on both the individual patient and the surgeon. A larger tumor potentially means a more technically challenging operation, and larger tumors have been associated with increased likelihood of requiring a re-excision.(77,78) Furthermore, larger tumor size has been associated with increased local recurrence

rates.(22,23,79) Larger tumor size may also mean a poorer cosmetic outcome. These reasons could bias the physician towards discouraging BCT and decrease the patient's own belief in the success of BCT.

6.6.3 Individual Factors

Individual factors can be subdivided into sociodemographic, travel-related, and personal belief and preference factors.

Common sociodemographic factors examined in studies include age, socioeconomic status (SES), and race/ethnicity. Age has been examined differently across the literature with discrepant results. The most consistent finding was an increased likelihood of mastectomy in younger age groups, under 40 or 50 years old.(13,68,69) The middle age groups have generally not shown significant findings. The older age groups have shown variable results, with some studies finding increased rates of mastectomy among those older than 70 or 80 but others showing decreased rates.(16,26,61,63) Furthermore, some studies have found no association between age and mastectomy rates were found.(47,102) Multiple studies have found higher SES or other indicators of SES, including education and income, to be associated with increased likelihood of BCT.(61,68,70,71) Ethnicities including African American women, Hispanic women, and Asian/Pacific Islander women have been shown to be independently associated with increased rates of mastectomy.(13,74)

Travel-related factors, including distance to a radiation treatment centre, have shown varying effects on BCT versus mastectomy rates. Although several studies found no difference(70,75,103), numerous studies have shown a decreasing rate of BCT as distance to radiation centre increases.(14,62,69,70) In our own qualitative exploration, we

hypothesized that travel distance would significantly affect rates of BCT for Saskatchewan's large rural population. However, our initial qualitative research did not support our hypothesis and further research in Canada would thus be useful for evaluation.(86)

Individual values and preferences may be the most important subset of individual factors but are the least well studied and THE hardest to understand. The majority of research into this category has been conducted through simple stand-alone questionnaires, or descriptive qualitative studies. Important personal belief and preference factors influencing choice of mastectomy include fear of recurrence desire to avoid radiation, desire for expedient treatment, and desire to avoid the consequences of BCT treatment.(16,17,47,75) Personal belief factors influencing choice of BCT include a view of mastectomy as being too radical, surgeon influence, feminine identity, and belief in equivalent survival between BCT and mastectomy.(72,76,86)

6.6.4 Physician Factors

Physician-related factors have also been examined throughout the literature. Multiple studies have shown that surgeon influence and recommendations are an important factor in treatment decision-making.(17,39,76,109) Various associations have been identified, including physician gender, case number, individual surgeon practice, subspecialty training, and academic hospital affiliation.(13,14,66) Results have differed across studies, with female surgeons being more likely to provide BCT in some studies, but less likely in others.(13,16,61) A few studies have also suggested that individual surgeon practice can be a predictor of procedural variation among colleagues.(39,64)

6.6.5 Procedural Variation in Surgery

Surgical variations between all procedures cannot be viewed as a whole. Wenneberg et al. proposed the grouping of practice variations into three categories: effective care, preference-sensitive care, and supply-sensitive care.(32) Effective care includes treatments that have good evidence behind one intervention in the absence of good alternative options. Examples include colectomy for colon cancer or repair of a hip fracture. Variations in this category generally suggest underutilization in lower use areas. Preference-sensitive care includes interventions for problems that have more than one acceptable treatment option, such as radical prostatectomy, radiotherapy, or active surveillance for prostate cancers and BCT or mastectomy for ESBC. Ideally, differences vary with patient preferences and values but they could vary for other reasons as well. Supply-sensitive care includes services limited by the availability of resources, such as of physician visits, hospital beds, or specialist consultations. Most surgical interventions do not fall under this category. Preference-sensitive care represents the largest of the categories for surgery, which includes decision-making between mastectomy and BCT in ESBC.

In 2014, Reames and colleagues published their results of a systematic review focusing on strategies for reducing regional variation in the use of surgery.(33) The review focused on two major strategies for improving consistency and the appropriateness of health care: dissemination of clinical practice guidelines or consensus statements and use of shared decision-making tools and decision aids. Clinical guideline dissemination produced demonstrated varied results, with some studies showing decreased rates, but others showing no effect or increased rates. Recommendations for procedure choice generally showed a measurable increase in the use of the recommended procedure. For BCT rates, some studies demonstrated a narrowed range of regional variation rates, but others

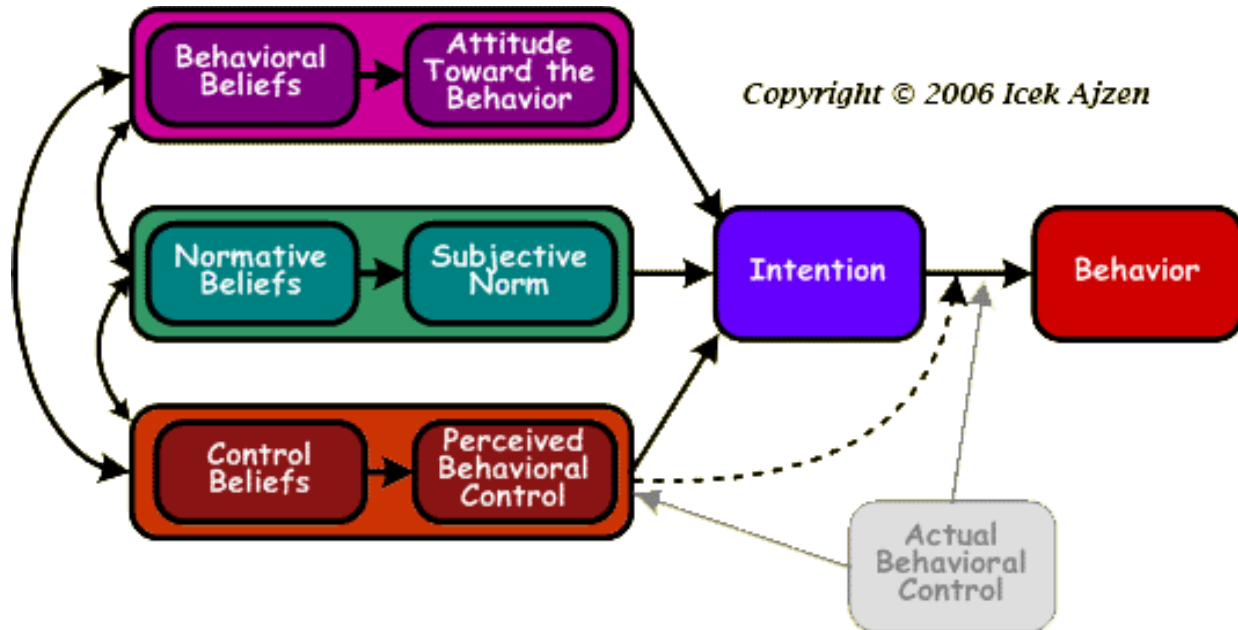
demonstrated a wider range. Decision aids also showed mixed results, with three of five studies not showing a statistically significant change in rate of procedure after administration and the other two studies demonstrating discrepant effects – one showing increased rates of BCT but the other showing decreased rates. Although the overall findings show that both clinical guidelines and shared decision-making tools have the potential to reduce the extent of variation in surgical care, these seem dependent on the clinical situation. These findings were confirmed by a recent Cochrane systematic review showing that decision aids were inconsistent in their ability to change outcome in terms of surgical variation.(34)

6.6.6 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a conceptual framework that links beliefs and behavior (Figure 6.2).(37,38) It has been frequently cited and has become one of the theories most commonly used to predict human functioning and behavior [60]. The theory states that the most proximal determinant of a given behavior is intention, which represents a person's motivation or decision to act. Intention, in turn, is a function of three sets of belief-based perceptions of behavior: attitudes toward the behavior, subjective norms, and perceived behavioral control (PBC). Attitude towards a behavior reflects a person's overall positive or negative feeling of performing the behavior. This is influenced by behavioral beliefs, which link the behavior of interest to a subjectively expected outcome. Subjective norms, which reflect the person's perception of the social pressure to perform a given behavior, are influenced by normative beliefs, or the perceived behavioral expectations of important referents to the individual such as family members, friends,

teachers, or doctors. PBC reflects a person's overall judgment about whether he or she has the ability and resources needed to engage in the target behavior.

Figure 6.2: Theory of Planned Behavior Diagram

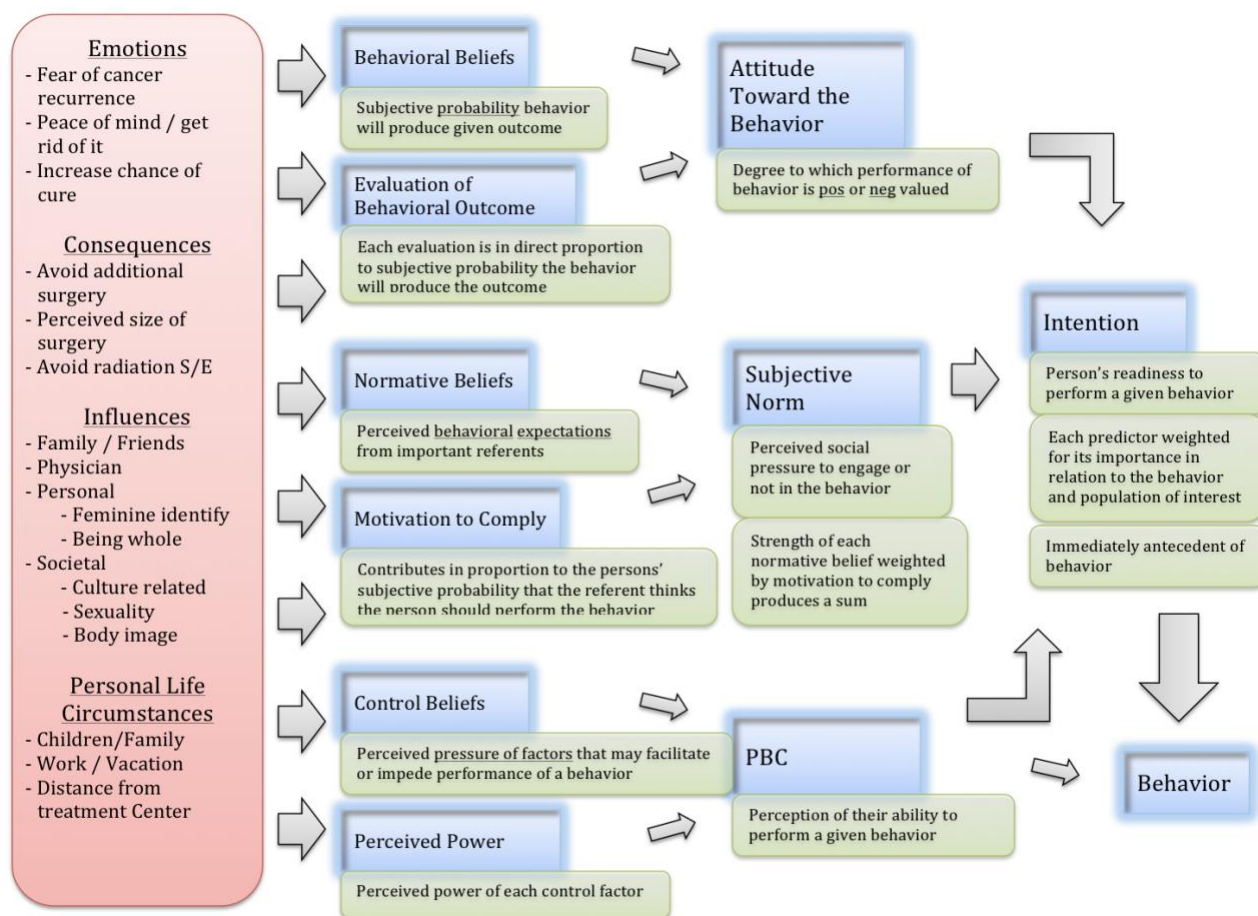


The TPB can be applied to decision-making for women who have ESBC. The behavior of choosing mastectomy or BCT can be conceptualized as a planned decision. Accordingly to Ajzen: '[t]he TPB emphasis is on the controlled aspects of human information processing and decision-making. Its concern is primarily with behaviors that are goal-directed and steered by conscious self-regulatory processes. From the TPB, expectations that performing a behavior will lead to experiencing pain, pleasure, regret, fear, elation, or other emotions are simply behavioral beliefs, i.e. beliefs about the likely consequences of the behavior, some positive and others negative'.(36) in prior research this theory has been used to study decision-making in cases of ESBC.(39)

TPB can be used to conceptualize and theoretically explain how different factors may influence a woman's choice of mastectomy or BCT. Sociodemographic characteristics

can influences on all three of the TPB belief constructs. Factors such as socioeconomic status or cultural background will directly relate to behavioral and normative beliefs. Personal life circumstances such as work obligations or distance from a treatment centre may affect a person's control beliefs. The influences of close family members and friends or a surgeon's recommendations will be among the key referents involved in an individual's subjective norms. Emotions such as fear of cancer recurrence and or peace of mind are often very important determinants of a woman's choice for mastectomy. These behavioral beliefs can strongly affect attitudes towards the behavior as well as subsequent behavioral intentions. Similarly, an individual's value of feeling whole or feminine after treatment may have a strongly influence on behavioral beliefs. Figure 3 illustrates how the TPB can be used to examine factors influencing the choice between mastectomy and BCT in cases of ESBC.

Figure 6.3: The TPB applied to factors influencing decision-making between mastectomy versus BCT



The TPB has been important in guiding our earlier research, specifically by serving as the theoretical foundation in an exploratory qualitative research project titled 'Understanding Women's Choice of Mastectomy Versus Breast Conserving Therapy in Early-Stage Breast Cancer'.⁽⁸⁶⁾ The TPB helped frame our qualitative research and organize our analysis, which included creation of thematic indices, coding, and creation of thematic maps. Although the TPB can potentially account for the full spectrum of factors influencing a patient's choice of therapy, it is best positioned for identifying and examining the individual belief and preference factors. The TPB is not structured well to account for broader clinical or health system factors. Moreover, the theory was designed to account for all human behavior and is therefore structured at a high level of abstraction, making it

difficult for clinicians to relate to in specific clinical situation such as when making a decision about ESBC management. We deemed the TPB insufficiently specific enough for our research, and decided instead to develop a more targeted and applicable framework. Nevertheless, incorporating aspects of the TPB and our prior qualitative research played a critical role in our creation of a new conceptual framework for examining why women choose mastectomy in the setting of BCT.

Figure 6.6.7 Patient-Physician Shared Decision-Making

In 1999, Charles et al. presented a framework for examining treatment decision-making that still informs today's decision-making concepts.(40) It included three models of treatment decision-making: paternalistic, shared, and the informed model. Each was distinguished into three separate steps, or analytic stages: information exchange, deliberation, and decision about what treatment to implement. The framework describes the general path that of the models follows as well as, more specifically, the behavioral expectations of both physicians and patients for implementing each model. The models' separate analytic stages make them easy to conceptually distinguish from one another. The framework also recognizes the dynamic nature of decision-making and does not limit one treatment interaction to one model, recognizing that an encounter may change as the interaction evolves.

In this framework, decision-making is related to situations in which several treatment options are available that offer different benefit-to-risk ratios, and different patient outcomes. Charles identifies four necessary characteristics(41):

1. At minimum, both physician and patient are involved in the treatment decision-making process.

2. Both physician and patients share information with each other.
3. Both physician and the patient take steps to participate in the decision-making process by expressing their treatment preferences.
4. A treatment decision is made, with both the physician and patient agree on the treatment to implement.

In the appropriate situations, the three models can be divided into three analytically distinct situations to help distinguish their characteristics. Information exchange refers to the type and amount of information exchanged, and the flow of information between physician and patient. Deliberation includes discussion of treatment options, and expression of treatment preferences. The last stage is the actual decision and the choice of which treatment to implement.

The paternalistic model has traditionally been the most prevalent approach to treatment decision-making, generally assuming the physician knows best how to make the optimal treatment decision for the patient. Information exchange is one-way in this model from physician to patient. The patient is a passive recipient, and information exchange from patient to physician is not seen as being important to completing this interaction. During the deliberation stage, the physician will consider the benefits and risks of each option alone or in consultation with other physicians, but the patient is passive. The physician makes the final treatment decision alone. This model is called paternalistic because it resembles to a parent-child relationship, in which the authoritative figure (the physician) makes what is deemed to be the appropriate decision for the patient.

The shared decision-making (SDM) model evolved with clinical medicine as treatment options increased for diseases, coupled with greater emphasis on discussion

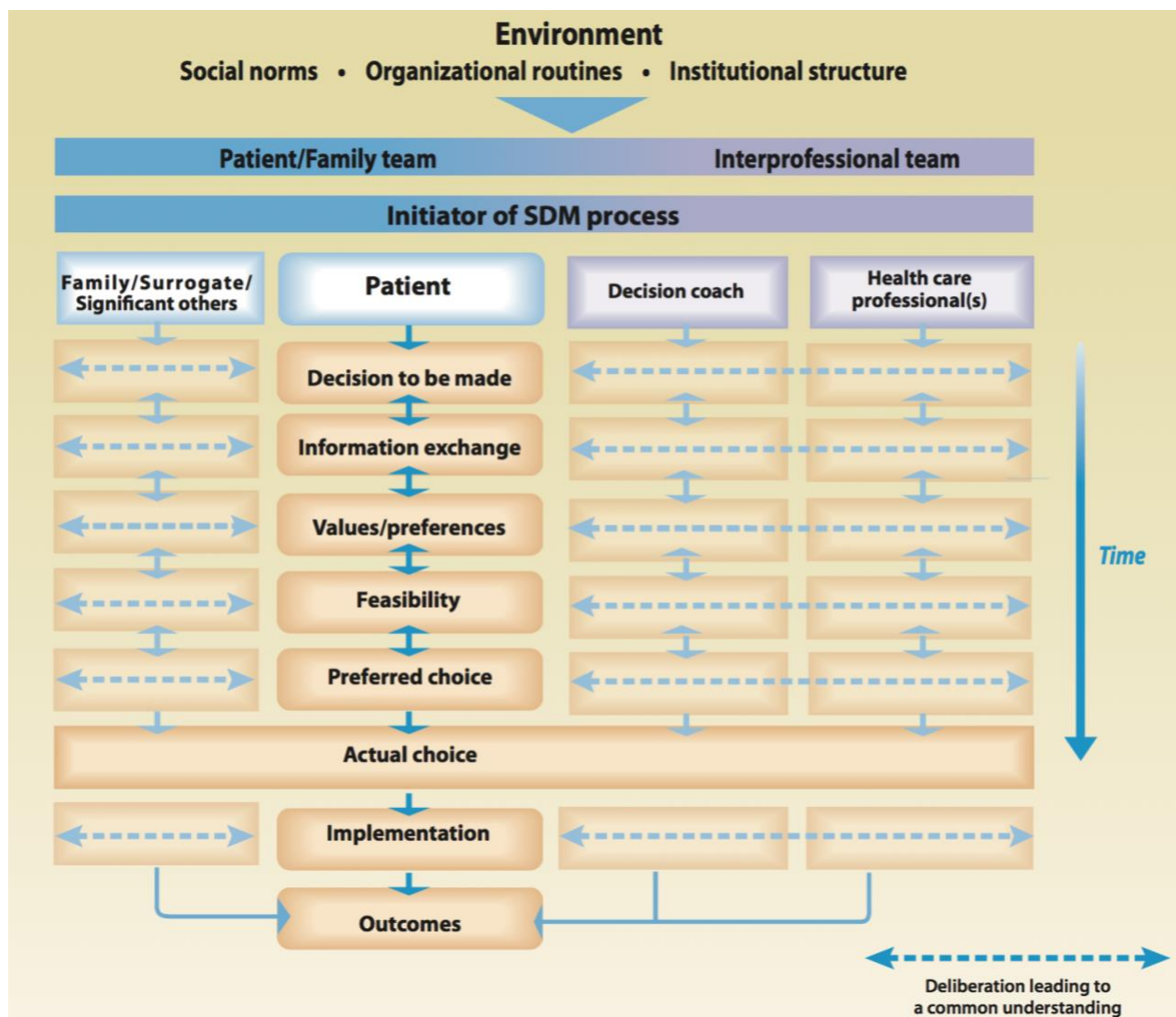
about tradeoffs between risks and benefits. Information exchange goes both ways in this model. The physician should provide the patient with all information needed to make a decision and the patient should provide information on issues related to the treatment options including values, preferences, social circumstances, and his or her knowledge about the illness. When this information is provided, deliberation can occur within the boundaries and context of the patient's specific situation. Deliberation should be interactional in nature, ensuring that both members have input and are invested in the treatment decision. Expression of treatment preferences is important to this model. The treatment used should be agreed upon between both the physician and patient.

The informed decision-making model differs from the SDM model in that the physician limits his or her role to providing information. Information exchange thus is largely one-way, with the physician as the primary source of information for the patient, who weighs all the treatment options, including and benefits and risks of each. Beyond information transfer, the physician does not participate in the decision-making process, leaving the patient to deliberate and make the final choice of the treatment on his or her own. An important fundamental difference from a shared model is that the physician should be invested in the decision-making process or in the decision made. This is to avoid influencing the patient towards a direction that reflects the physician's treatment bias, which might not align with the interests of the patient.

SDM scholars have recently pushed for the creation of a model that extends beyond the physician-patient dyad while promoting an interprofessional approach to SDM. France Légaré, Dawn Stacey, et al. proposed a new interprofessional shared decision-making (IP-SDM) model with which to guide patient care.(42,43) The model comprises of three levels:

the individual (micro), the health care team/organization (meso), and the health care system (macro) levels (Figure 6.4).[65] For an IP-SDM approach, this model assumes that multiple healthcare professionals from different professions collaborate, concurrently or sequentially, to achieve SDM with the patient. The model also assumes that clinical encounters cannot occur independent of the influence of factors from the health care system levels. This model has the potential to unify the process of SDM in different healthcare settings and with different health professionals.

Figure 6.4: IP-SDM model



The individual level of care is similar to the Charles et al. (1999) model but incorporates multiple health care professionals, a decision coach, and family members who are explicitly involved through the information, deliberation, and treatment decision stages. The meso level of the IP-SDM model is represented by the IP team members and features how the team or organization functions. The macro level represents global healthcare environmental factors: resources, government policies, cultural values, professional organizations, and rules. IP-SDM being a newly proposed model that has had limited development or application in real-world clinical scenarios, requires further work to clarify the meso and macro levels.(43,44) Currently in many North American health care systems, treatment decisions related to breast cancer surgery are made primarily with the involvement of a single health care professional, the surgeon. However, the role and involvement of both medical and radiation oncology in the decision-making process are expanding, prompting discussions of the various lengths of radiation treatments and differing chemotherapy indications, which may increase the role of the IP-SDM model in the future.

These models illustrate the complexities behind patient-physician treatment decision-making. For ESBC, definitive care is centred on surgery, so a decision between the patient, with his or her supports, and the surgeon determines treatment choice. The shared decision-making frameworks presented highlight the physician's influence on the patient's choice of therapy, specifically by bringing to light some of the complexities behind the physician-patient interaction that are not generally captured in the clinical literature. Whether interactions between the physician and patient following the paternalistic model, the shared model, or the informed model will bring varying degrees of physician influence

on the patient, differentiated through the analytic steps. Depending on the style of interaction, patient values, beliefs, and preferences will be incorporated into the treatment decision to varying degrees. Apart from the decision-making process as described by the SDM models, the impact of surgeon trust needs to be considered; this can be explained through the normative beliefs construct in the TPB. The influence of trust is especially strong for women, who highly value the recommendations and expectations of their surgeon. Recognizing the importance of the patient-physician relationship has led to 'physician factors' being a key construct in our conceptual framework. We understand that this interactive relationship is complex, and that it differs among individuals, but we have presented some of the leading thoughts on how to examine this relationship's influence on decision-making.

6.7 Discussion

The framework we have presented in this article was designed to examine factors influencing women's choice of mastectomy versus BCT in ESBC only (stage 1 and 2). It was not designed for patients who have ductal carcinoma in situ (DCIS), high risk patients such as those who have BRCA, or patients who have advanced disease such as stage 3 or 4 breast cancer. Although it may be considered for use in these clinical situations, we advise adaptation and critical thinking, for the treatment decisions and influencing factors will be different than for ESBC.

We believe that the three constructs created – clinicopathological factors, individual factors, and surgeon factors – are appropriate domains for organizing and categorizing the potential influencing factors influencing women's choice. These constructs were developed with a view to allow clinicians to readily visualize and understand them as individual

domains of factors as well as within the broader context of the framework as a whole. The framework purposefully places the individual in the centre, for treatment is focused on the individual patient. The three constructs have been equally weighted, for the importance of each can vary depending on the individual. Clinicians should approach each clinical encounter without bias towards one construct.

We recognize that conceptual frameworks are often dynamic entities and invite commentary and alteration as needed.

6.8 Conclusion

In this article, we have presented a conceptual framework that is both unique and novel. It is important to remember that each framework is created to present a view of a phenomenon through a specific lens. These lenses can vary in scope and level of abstraction, and can highlight different constructs for the topic at hand. We have created a conceptual framework for examining why women choose mastectomy compared with BCT with the purpose to help health care workers and policy makers better understand the multitude of factors that influence a patient's choice of therapy at an individual level. From a research stance, we hope that future scholars will use, challenge, and build upon this in their own work on decision-making in the setting of breast cancer. For clinician-researchers who have limited experience with frameworks, we hope that this paper has highlighted the importance of using a conceptual framework to guide future research and has provided a base from which to begin doing so. For more experienced academics, we invite feedback and express our hope for continued growth in this field.

List of abbreviations

BCT – Breast conserving therapy

DCIS – Ductal carcinoma in situ

ESBC – Early stage breast cancer

IP-SDM - Interprofessional shared decision-making

PBC – Perceived behavioral control

SDM – Shared decision-making

SES – Socioeconomic status

TPB – Theory of Planned Behavior

6.9 Declarations

Ethics approval and consent to participate – Not applicable.

Consent for publication – Not applicable.

Availability of data and material – Not applicable.

Competing interest – The authors declare that they have no competing interests.

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Author's contributions – Jeffrey Gu and Gary Groot have both made substantive intellectual contributions throughout this study, including in the conception, design, writing, and revision of this manuscript.

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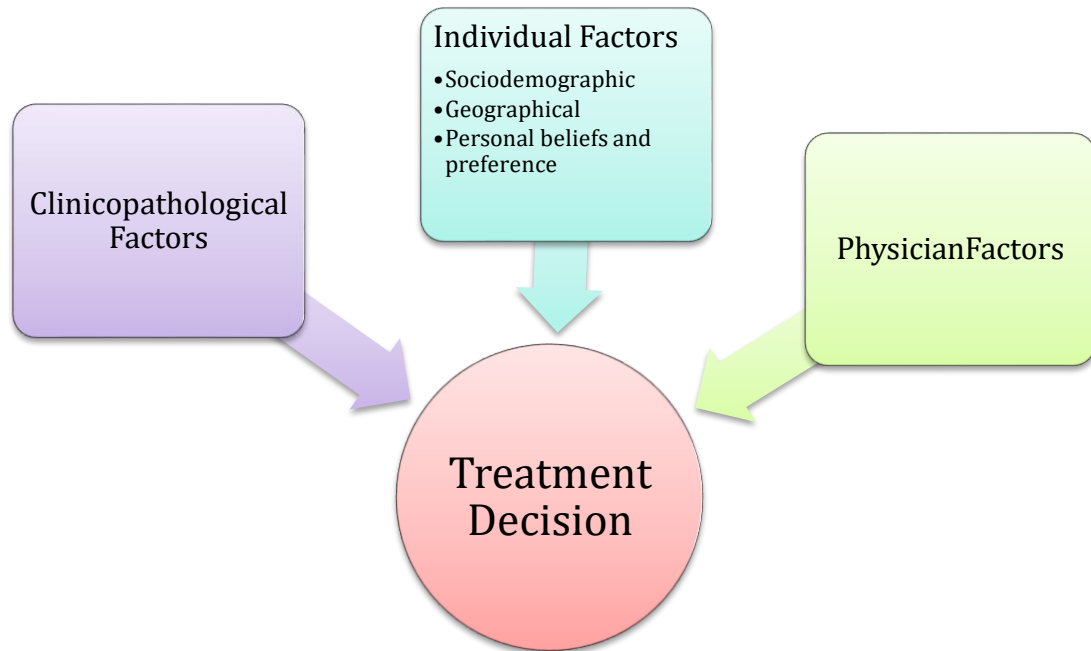
Author's information – The lead author, Jeffrey Gu, is a general surgery resident completing his PhD in Community Health and Epidemiology (CHEP) at the University of Saskatchewan. He is working with and supervised by the co-author, Gary Groot, who is a surgical oncologist and an associated professor in the department of CHEP. The focus of their research is on understanding why women with ESBC choose mastectomy versus BCT in Saskatchewan. The development of the framework introduced is part of this program of research. Creation of the framework was guided by an initial qualitative project as well as background literature. The framework itself was essential in guiding a completed systematic review and a province-wide survey-based study.

CHAPTER 7: SURVEY DEVELOPMENT

7.1 Survey Conceptual Development

The construction of our survey was based on the conceptual framework of what influences women to choose mastectomy versus BCT (see Chapter 6 for full details). This framework, which illustrates the central constructs that underlying women's choices, is presented again Figure 7.1. The creation of this framework was based on previous literature, which is further explained below, prior theory, prior models, and the initial exploratory qualitative research. We have organized women's choice of mastectomy versus BCT into three broad influencing constructs: clinicopathological factors, physician factors, and individual factors. These constructs have often been measured individually, or in fragmented combinations in the past. With our survey, we planned to study these constructs holistically in a way that links them together. By examining how each factor and their interactions influence a patient's choice, we hoped to gain greater overall understanding of this phenomenon.

Figure 7.1: Conceptual framework illustrating the central constructs influencing women's choice between mastectomy versus BCT.



7.2 Survey Organization

The survey as a whole is aimed at capturing influences from the three main constructs: clinicopathological factors, individual factors, and physician factors. The survey is composed of a questionnaire and a dataset from the Saskatchewan Cancer Agency (SCA). The questionnaire is aimed at capturing individual values or preference factors, potential decisional conflict factors, travel-related factors, and individual demographic factors. A dataset from the SCA, which is linked to the questionnaire data, captures clinicopathological factors for the patients. The survey as a whole can be seen in Appendix H.

7.2.1 Clinicopathological Data from the Saskatchewan Cancer Agency

The researchers collaborated with the research group from the SCA to obtain clinicopathological data to link with the questionnaire participants. Data items collected were based on previous literature described in the conceptual development of the survey. Data items collected are listed below:

1. C-code
2. C-code English description
3. Morphology
4. Morphology English description
5. Behavior
6. Grade
7. Laterality
8. Multiplicity Counter
9. Tumor Size
10. Regional Nodes Positive
11. Regional Nodes Examined
12. SSF 1 – ER Assay
13. SSF 2 – PR Assay
14. SSF 14- HER2: Result of Other or Unknown Test
15. SSF 16 – Combination ER, PR & HER2
16. Overall Stage, T, N and M stage values
17. Surgery Date
18. Radiation therapy
19. Chemo therapy
20. Hormone therapy

A full legend describing the breast data set is in Appendix I.

7.2.2 Individual Sociodemographic Factors

Demographic factors such as age, SES, and race / ethnicity have also shown varying associations with treatment choices (specific details described in Chapter 4). This questionnaire included questions on age, ethnicity, income, education, occupation, and relationship status to capture this data.

The Statistics Canada defines ethnic origin as ‘the ethnic or cultural origins of the person ancestors. An ‘ancestor is usually more distant than a grandparent’.(113) In the 2016 census, they collected ethnic origin data on eight major categories, with over 100 subcategories.(113) While we have used the term ‘Caucasian’ in our survey, we recognize this term is derived from an old classification, and there may be better terms such as Caucasoid, European, or White to use in the future.(114)

7.2.3 Geographical Factors

Travel related factors or distance to a radiation treatment centre have shown varying results in the literature as to whether there is an effect on rates of BCT versus mastectomy (specific details described in Chapter 4). We hypothesized that in Saskatchewan, travel distance would significantly affect rates of BCT due to Saskatchewan's large rural population. Interestingly, the initial qualitative research did not support this hypothesis. Nonetheless, it is important to evaluate potential geographic barriers to therapy choice. This questionnaire included questions on travel distance to surgical and radiation treatment centres, rural versus urban living location, and lodging for radiation treatments.

7.2.4 Personal Beliefs and Preferences Factors

The individual values and preference factor questions emerged from the results of our initial qualitative study, which was also based in Saskatchewan (see Chapter 6). The results of that study gave us a guiding list of factors that influenced patients' choice at an individual level. The initial qualitative process further aided in organizing these factors into dominant themes and their accompanying subthemes or secondary factors. These are displayed in Table 7.1. This organization directly informed how we created our questionnaire and the use of branching logic.(115) Branching logic, or skip logic, is a feature that changes what question a respondent sees based on how they answer previous questions. This was done to ensure all questions were relevant to respondents. For example, if a participant responded to an initial question about 'worry about cancer recurrence' as an important factor, they would subsequently have a follow-up question inquiring about what the reason behind that worry was with response options also based on the initial study. However, if a participant did not rate that factor as important, they

were not asked specific follow-up questions. As well, there were some belief factors that are specific to either mastectomy or BCT groups only. These questions were asked of only the applicable group.

Table 7.1: Individual Values and Preference Factors

Mastectomy Participants

- A. Worry about cancer recurrence
 - a. Causes of this worry:
 - i. Observed failed BCT (family / friend)
 - ii. Observed mastectomy success (family / friend)
 - iii. Avoiding follow-up imaging
 - iv. Family history of breast cancer
 - v. Age
 - b. Increasing chance of cure
 - c. Obtain peace of mind
 - d. Get rid of all of the tissue
 - e. Wanting a prophylactic mastectomy
- B. Avoiding consequences of BCT treatment
 - a. Avoiding potential for additional surgery
 - b. Avoiding radiation therapy
 - i. Travel distance for radiation treatments
 - ii. S/E of radiation
- C. Breast-tumor size ratio
 - a. Perceived small breasts
 - b. Perceived large tumor

BCT Participants

- A. Mastectomy is too radical
 - a. Relative to perceived tumor size
 - b. Confidence in BCT procedure
 - c. Perceived recovery time too long
 - i. Influenced by age
 - ii. Influenced by comorbidities
- B. Surgeon influence
 - a. Surgeon's recommendations
 - b. Reputation of the surgeon
 - c. Reasons behind surgeon choices:
 - i. Perceived breast size
 - ii. Perceived tumor size
- C. Feminine identity
 - a. Body image
 - b. Sexuality / desirability / attractiveness
 - c. Being whole / retaining one's own breast tissue

7.2.5 Physician Factors

Previous literature on physician factors have largely focused on physician demographics such as gender, age, type of training, and practice patterns (specific details described in Chapter 4). Evaluating these factors was impractical in our study as there are greater than twenty surgeons from eight different surgical centres in Saskatchewan. Additionally, due to ethical and logistical restrictions, we were unable to link patient treatment to individual physicians' care. Instead, we focused on the patients' perceptions of the physician's influence. The questionnaire evaluated the physician interaction and their perceived influence of on therapy decision-making.

To help evaluate an aspect of physician interaction, we utilized the Decisional Conflict Scale (DCS), which is a 16-item questionnaire that was designed and validated by O'Connor to examine decisional conflict and other aspects of the decision-making process.(116) The scale has five sub-scales: certainty, information, clarification of values, support or pressure from others, and the respondent's perception of the quality of the decision process. The DCS has been used in the past to do the following: diagnose a patient's decisional conflict, identify the patient's decision support needs (knowledge, values clarification, support), determine the quality of the decision process, and evaluate the impact of decision support interventions.(117,118) Each item is measured on a 5-point Likert scale with total scores between 0-100, with 100 indicating extremely high decisional conflict. The DCS is designed to have the specific wording of questions adapted for each questionnaire on different topics. The DCS was adapted for use in our survey, which is also included in Appendix H.

7.3 Survey Questionnaire Design

This questionnaire was designed in accordance with best practice recommendations from Jon Krosnick and Stanley Presser.(115) Beyond obtaining the correct information from questions, we aimed to maximize optimal patient responses and minimize satisficing tendencies. Some general principles we followed were using simple familiar words, avoiding ambiguous meanings, making sure response options were exhaustive and mutually exclusive, avoiding leading or loaded questions, and only asking about one thing at a time. Following these principles meant that many of our answers included a combination of close-ended responses with an open ended 'other' response to ensure the participants could be exhaustive in their responses. A 5-point Likert scale with values from strongly disagree to strongly agree was chosen because using word labels has shown higher reliability in questionnaires and avoids acquiescence.(115) If respondents attempted to advance to the next question without responding to the question, they were prompted to answer the question, but not forced into an answer.

The order of questions was also crafted under best practice principles for this questionnaire.(115) Questions of similar topics and concepts were grouped together, which followed a funneling technique of proceeding from general to specific. Questions under the same domains of interest were randomized to prevent question order effect biases. Filter questions were included, where appropriate, to avoid asking respondents questions that may not apply to them. Questions were placed at the start of the survey that explicitly address the main topic of the survey and are the most cognitively challenging to optimize responses. Factual and demographic questions were placed at the end of the survey, as these topics are less susceptible to satisficing.(115)

7.4 Questionnaire Pre-testing

This survey underwent multiple iterations of pretesting. The researcher, his supervisors, and collaborators created an initial version of the survey with the U of S Social Science Research Lab (SSRL) survey designer. The survey then underwent pre-testing with methodology experts in survey design, as well as the Saskatchewan's Breast Advisory Group. Specific considerations that were asked to be reviewed during pre-testing included: specific wording choices, question ordering and grouping, content covered, and question appropriateness with the target population. Survey methodology experts within various departments at the U of S were consulted including in psychology, epidemiology, and the director of the SSRL. The Saskatchewan's Breast Advisory Group is composed primarily of breast surgeons, but also has representation from oncology and the SCA. Changes made to the questionnaire were iterative.

7.5 Questionnaire Piloting

To pilot the study, we collaborated with the Saskatoon Breast Health Centre. This was an external participatory pilot survey, meaning the pilot participants were not included in the main survey, and we informed the respondents that we were in a pilot phase, and asked them for constructive feedback upon survey completion. The inclusion criteria for pilot participants were the same as for our main survey – Saskatchewan women who have been diagnosed and treated for ESBC (stage 1 or 2). Excluded from the study were women with DCIS, known BRCA, stage 3 or 4 breast cancer, male breast cancer, and inflammatory breast disease. Potential participants were those diagnosed after December 31, 2015 to

avoid overlap with participant recruitment for our main survey data. 40 participants partook in the pilot process, which was about 10% of our survey's goal sample size.

The Breast Health Centre nurses helped identify potential participants that met our pilot inclusion criteria. They then asked the patients if they would be interested in speaking with the researcher / interviewer, J.G., about the study when they were at the Saskatoon Breast Health Centre for an appointment. A study information pamphlet was available for the nurses to utilize as well (Appendix J). If the patient agreed, J.G. spoke to them about the study and obtained consent using the same consent form as for the main survey.

Participants were encouraged to evaluate the survey design and record problems they may have come across with any portion of the survey; pen and paper were also provided.

Participants were asked to complete the survey online in a self-administered fashion; a tablet device was provided to allow participants to complete the survey on-site.

Alternatively, the participants could ask the researcher to administer the survey in person.

If this was requested, the interviewer entered the responses into the Qualtrics™ program to maintain centralized data. Upon completion of the survey, the pilot participants were asked to provide feedback on the survey. Specific feedback questions targeted question wording, appropriateness, relevance, terminology, response categories, repetitiveness, other comments or criticisms, and general feedback. Field notes were recorded. No identifying data were recorded beyond what was asked in the survey.

7.6 Sample Size

The sample size calculation was based on our framework and the central constructs that influence women's choice between mastectomy versus BCT (Figure 7.1). The constructs include clinicopathological factors, physician-related factors, and individual

(patient-based) factors. For each of these factors we calculated sample sizes required to detect differences between mastectomy and BCT groups for one main difference of interest in each construct group. All chosen sample size values were from studies with multivariate analysis, and odds ratios were selected throughout. Based on CIHI data, there are approximately 478 Saskatchewan patients diagnosed with ESBC per year, of whom 53% initially undergo mastectomy and 47% BCT.(12) We assumed the two groups proportions to be equal, 50% each in our calculations. Sample sizes were calculated using PASS software.(119) Tests for two proportions detecting inequality using odds ratios were performed.

For clinicopathological factors, Locker et al found tumor size greater than 2cm was associated with an odds ratio (OR) of 3.03 times higher likelihood of undergoing mastectomy.(63) We wanted to determine if this factor would likewise be significantly in our study population. If the ratio between the two groups, group A (BCT) and group B (mastectomy), resulted in anything other than the null value of 1, we would conclude that tumor size is an important variable. Sample size for this factor was calculated using data from Locker et al study, looking at the odds of outcome in group A, $p_A(1 - p_A)$, compared to with the odds of outcome in group B, $p_B(1 - p_B)$, where p_A and p_B are the probabilities of the outcome in the two groups.

The null hypothesis: $H_0: OR = 1$

The alternate hypothesis: $H_0: OR \neq 1$

$$OR = \frac{p_A(1 - p_B)}{p_B(1 - p_A)}$$

Using PASS, the sample size required to detect a difference between group A and B for tumor size was 102.

Similar sample size calculations were performed for constructs in other groups. For physician-related factors, Cyran et al found that female physician gender was associated with an OR of 3.80 times higher likelihood of undergoing BCT.(16) Using this information and PASS, the sample size required to detect this difference was 78. For individual factors, we chose to test both travel distance as well as personal beliefs and values factor. Celaya et al found that travelling a distance to radiation facility greater than 60 miles was associated with an OR of 0.31 times less likelihood of undergoing BCT.(62) Based on this study, the sample size required to detect this difference was 92. Lee et al found that women who strongly valued peace of mind were associated with an OR indicating 1.88 times higher likelihood of undergoing mastectomy.(45) As the proportions of women valuing peace of mind were not given, we tested a range of possible proportions from 35% to 45% for those not valuing peace of mind choosing mastectomy. This sensitivity testing revealed that changing the proportion did not significantly affect our sample size. Taking the above into account, the sample size required to detect this difference was 320 with a proportion valuing peace of mind choosing mastectomy being 60%. Outputs for all calculations are included in the appendix. (Appendix K)

The individual factor of peace of mind required the highest sample size to detect a significant finding of interest and was used as a base sample size. To account for the multivariable nature of this study, potential confounders, and our hypothesis that all of these constructs may influence women's choice, we increased the sample size to account for confounding from each construct. The adjustment was calculated by increasing the sample size by 15% per each additional construct. Our final goal sample size was 423 participants.

7.7 Target Population

Our target population included all women diagnosed and treated with ESBC in Saskatchewan. ESBC is defined as women with stage one or two breast cancer as per the NCCN guidelines.(19) Participants had to be residents of Saskatchewan. Excluded from this study were women with DCIS, known BRCA, stage three or four breast cancer, male breast cancer, and inflammatory breast cancer.

7.8 Ethics Approval

Ethics approval was obtained from the University of Saskatchewan Behavioural Research Ethics Board (Beh-REB). The ethics file is Beh 15-355.

7.9 Patient Recruitment

Patient recruitment was done with the support from the Saskatchewan Cancer Agency. Through the SCA database, all patients who were treated for ESBC in Saskatchewan during an inclusive 2-year period from January 2014 to December 2015 were identified. Inclusion dates were based on the date of the procedure that led to their pathological diagnosis, i.e., biopsy date for invasive cancer. Patients were mailed an invitation letter to participate from the SCA (Appendix L). If there was no response to our initial survey request, a single reminder invitation to participate letter was sent out at an 8-week interval from the initial letter. The initial invitation to participate letter was mailed out on December 7th, 2017 and the reminder letter was mailed out February 2nd, 2018. Closure of the survey and data collection ended on April 4, 2018. No incentive-based recruitment strategies were employed with this survey.

The SCA does track and remove deceased individuals from their database. However, if any of these patients were missed and a family member contacted and informed the researchers the individual was deceased, these numbers were tracked and removed from response rate denominator. As well, if a participant called to inform the researcher they did not meet our study inclusion criteria, we also removed these individuals from our study denominator. We tracked these with the individual survey's unique linking variable to protect the participant's confidentiality.

Based on 478 patients per year diagnosed with ESBC,(12) we estimated that a recruitment response of 45% would allow us to reach the goal sample size during the 2-year period.

7.10 Survey Implementation

The proposed survey was hosted online by Qualtrics™, a program that the SSRL uses frequently. During the piloting phase of the study, servers were located in the USA and subject to US laws. The privacy of the information provided was subject to the laws of that other jurisdiction. However, at the time we conducted the primary survey, database servers were relocated to Canada and were subject to Canadian privacy laws; the data collection system at the SSRL was also changed to Voxco at this time. Participants were encouraged to complete the survey online in a self-administered fashion. Alternatively, the participants could contact the researchers and have the survey administered via a phone interview. There was a separate oral telephone script consent form that the researcher followed. (Appendix M) During the phone interview, the interviewer entered the participant responses into the Voxco program to maintain centralized data.

7.11 Data Collection and Management

All questionnaire data were collected via the Voxco system. These data can be exported to Excel. Survey clinicopathological data including tumor location, pathology, staging, and adjuvant treatment information was obtained from the SCA database. These datasets were linked using a linking variable, the individual participant code.

Each potential participant recruitment letter included a unique patient identifier. This identifier was composed of two sections: a 4-character number – character – number – character combination, and a four-digit number running from 0000 to 1000. These two components were combined to create an 8-character unique patient identifier for all patients in our target population. The first 4 characters would make incorrect entry of the unique identifier very unlikely. The last 4 digits would make it easier for the researchers, who did not have access to the master list, to link the two datasets together. With a sample size of over 400 participants and a total target recruitment population of close to 1000, this number would not be able to be used as an identifying feature. A master code sheet was kept to track the patients. The creation of a master code sheet linking identifying patient information to the data sets was created and kept within the SCA at all times. The researchers did not have access to the master code sheet at any time.

All original data files were stored in a passcode protected computer that was secured in a locked room at all times.

7.12 Data Analysis

Statistical analysis was performed using Stata 14.2.(120) Our primary outcome was odds of mastectomy versus BCT. Independent variables included clinicopathological factors,

individual patient factors, and physician factors. Baseline differences between groups were evaluated using chi-squared test for categorical data and independent sample *t* test for continuous data. Univariate logistic regression was applied to identify key predictors of choice of mastectomy versus BCT. Multivariable logistic regression analysis was used to create the main effects model. Variables with a $p < 0.10$ in the univariate logistic regression were included in the multivariable model and backwards elimination of variables with $p < 0.05$ was then performed. Clinically important effect modifiers were individually tested for potential inclusion in the model using an interaction term. Goodness of fit was assessed using the Akaike information criterion. For missing data, we used complete case analysis when there was less than 10% and indicator method when more than 10% of missing data points to reduce bias.

Geocoding and mapping was performed in conjunction with the Spatial Division of the U of S Social Sciences Research Laboratories. Geocoding was performed by joining spatial information (latitude and longitude) to patients' home based on the first 3 letters of postal code provided. Visualizing routes and generating GIS files was done using a WebGIS solution developed by the local team to visualize patients' home location, hospital locations, and travel routes. These routes were manually edited as arcs and routes were downloaded as GIS layers. GIS layers were imported to create PDF maps using ArcGIS.

7.13 Additional Results from Survey Not Included in Manuscript

There are additional methods and results from this survey that were not included in the manuscript (Chapter 8) but deemed important for this dissertation. These are detailed in Appendix N.

CHAPTER 8, MANUSCRIPT #4: MASTECTOMY VERSUS BREAST CONSERVATION THERAPY: AN EXAMINATION OF HOW INDIVIDUAL, CLINICOPATHOLOGICAL, AND PHYSICIAN FACTORS INFLUENCE DECISION MAKING

This article was submitted to the journal *The Breast* on November 24, 2018.

The general content included in this article does not significantly differ from the published manuscript. However, grammatical modifications, minor changes to tables and figures, and some additional explanations have been included. The document has also been reformatted from the original version for inclusion in this thesis.

Additional results from this study not included in the submitted manuscript are included in Appendix N.

8.1 Abstract

Background and objectives: The choice of mastectomy versus breast conservation therapy (BCT) in early stage breast cancer (ESBC) is a complicated decision-making process. Canada's interprovincial mastectomy rates vary from 25% to 68%, with Saskatchewan reporting the nation's second highest mastectomy rate, at 63%. The aim of our research was to better understand why women with ESBC choose mastectomy compared with BCT in Saskatchewan.

Materials and methods: We created a survey based upon a previously developed framework that organizes the influencing factors into three constructs: clinicopathological, physician, and individual belief factors.

Results: Treatment choice was influenced by disease stage and multiple individual belief factors. Women who had stage two disease were significantly more likely to undergo mastectomy than those who had stage one disease (OR, 7.48). Patients rating 'worry about cancer recurrence' (OR, 3.4) and 'total treatment time' (OR, 1.8) as more influential on their choice were also more likely to undergo mastectomy. Conversely, women rating 'wanting to keep own breast tissue' (OR, 0.17), 'tumor size' (OR, 0.66), or 'surgeon's opinion' (OR, 0.69) as influential to their choice were more likely to undergo BCT.

Conclusions: Our study demonstrates that treatment choices for Saskatchewan women who had ESBC were primarily influenced by disease stage and individual belief factors. These findings would suggest that women are making their treatment choices predominantly based on individual values and preferences. The use of mastectomy and BCT

rates as an indicator of quality of care may be misleading. Instead, a shift in attention towards patient-centred care is more appropriate.

8.2 Keywords

Breast cancer; decision-making; mastectomy; breast conserving therapy; patient centred care.

8.3 Abbreviations

ESBC = early stage breast cancer

BCT = breast conservation therapy

SCA = Saskatchewan Cancer Agency

SES = socioeconomic status

8.4 Introduction

8.4.1 Research Problem

In North America, breast cancer is the most commonly diagnosed cancer and the second most common cause of cancer death in women.(1) For early stage breast cancer (ESBC), it is well established that breast conservation therapy (BCT) and mastectomy are equivalent treatments for survival.(2,4,6,9) Treatment for ESBC can thus be viewed as preference sensitive care, in which decision-making between treatment options varies with according to patient preferences.(40) In Canada, interprovincial mastectomy rates vary greatly from 25% to 68% between provinces, with a national average of 38%.(11) Saskatchewan has consistently reported the nation's second highest mastectomy rate with the latest report showing 63%.(12,27) International research has investigated why women choose mastectomy compared with BCT,(13,39,45,68,72,121) but there are few data from Canada to explain these provincial variations.(12)

The equivalent efficacy of mastectomy and BCT for treatment of ESBC suggests that treatment choice should be made based on underlying patient values and preferences; however, mastectomy rates have repeatedly been used as performance and quality indicators.(122–125) This stems from the National Institute of Health Consensus Conference in 1999, which recommended BCT as 'preferable' to mastectomy because it was thought as less invasive and cosmetically superior.(10) Researchers have frequently cited 'underuse' of BCT(16) and even called BCT the 'standard of care' in some studies.(64) Viewing procedural variation through a patient-centered care lens, as opposed to a standard of care assessment allows researchers to explore existing variations with curiosity rather than judgement. Research conducted to understand what drives patients' decision-

making will not only help guide evaluation of quality of care in the setting of ESBC but also allow for identification of areas of focus for quality improvement. The aim of our research is to better understand why women choose mastectomy compared with BCT in Saskatchewan.

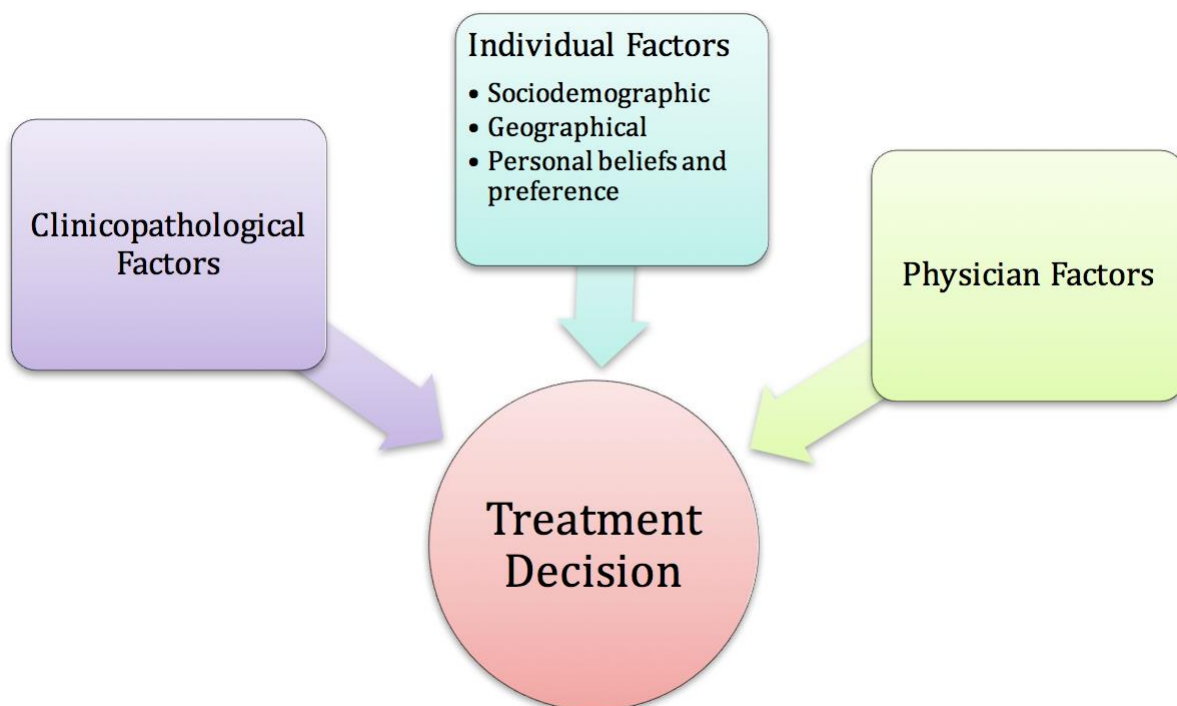
8.5 Material and Methods

Approval was obtained from the University of Saskatchewan Behavioural Research Ethics Board.

8.5.1 Survey Conceptual Development and Design

This survey is the second stage of a sequential mixed-methods study.(86) The construction of our survey was based on a previously developed conceptual framework, as shown in Figure 8.1.(95) This framework provided a logical guide to organize our inquiry while maintaining the individual patient decision as the central focus.

Figure 8.1: Conceptual framework illustrating the central constructs influencing women's choice between mastectomy versus BCT



This framework organizes the potential influencing factors affecting women's choice between mastectomy versus BCT into three central factor constructs: clinicopathological, physician, and individual with subgroups of sociodemographic, geographical, and personal belief factors.

The survey is composed of an online questionnaire linked with a clinicopathological dataset from the Saskatchewan Cancer Agency. The questionnaire was designed in accordance with best practice recommendations from Krosnick.(115) For individual factors, all participants were asked to rate fourteen personal belief questions on a 5-point Likert scale. Five additional factors were mastectomy-specific and two were BCT-specific. For physician factors, participants were asked to reflect on the physician's involvement in the treatment decision-making process on a 5-point scale ranging from entirely the individual's choice to entirely the physician's choice, with a shared-decision in the middle. A detailed explanation of the survey design and the full survey can be viewed in Appendices A and B.

8.5.2 Study Participants

Our study population included all Saskatchewan women diagnosed and treated with ESBC in 2014-2015. ESBC was defined as women who had stage one or two cancer (AJCC 7th edition).(19) Patients who had DCIS, known BRCA, stage three or four breast cancer, male breast cancer, and inflammatory breast cancer were excluded.

Participant recruitment was done in collaboration with the Saskatchewan Cancer Agency (SCA). Through the SCA database, all patients treated for ESBC in Saskatchewan during the inclusive two-year period from January 2014 to December 2015 were identified. Patients were mailed a letter from the SCA inviting them to participate in December 2017, with a single reminder invitation eight-weeks later (Appendix C). Data collection ended on April 30, 2018. No incentive-based recruitment strategies were employed.

The questionnaire was hosted online through Voxco.(126) Participants were encouraged to self-administered the survey online. Alternatively, the participants could call the researcher and have the questionnaire administered via a phone interview.

8.5.3 Data Collection and Management

Clinicopathological data including tumor location, pathology, and staging were obtained from the SCA database and linked to the questionnaire data using a unique eight-character alphanumeric identifier that patients also used to access the online survey.

8.5.4 Data Analysis

Statistical analysis was performed using Stata 14.2.(120) Our primary outcome was odds of mastectomy versus BCT. Independent variables included clinicopathological factors, individual patient factors, and physician factors. Baseline differences between groups were evaluated using the chi-squared test for categorical data and independent sample *t* test for continuous data. Univariate logistic regression was applied to identify key predictors of choice of mastectomy versus BCT. Likert scale variables were treated as ordinal variables. Multivariable logistic regression analysis was used to create the main effects model. Variables for which $p < 0.10$ in the univariate logistic regression were included in the multivariable model, after which backwards elimination was performed of variables for which $p < 0.05$. Clinically important effect modifiers were individually tested for potential inclusion in the model using an interaction term. Goodness of fit was assessed using the Akaike information criterion. For missing data, we used complete case analysis when less than 10% of data points were missing and the indicator method when more than 10% were missing to reduce bias.

Geocoding and mapping were performed in conjunction with the Spatial Division of the University of Saskatchewan Social Sciences Research Laboratories. Geocoding was performed by joining spatial information (latitude and longitude) to patients' home based on the first three letters of the postal code provided. Visualizing routes and generating GIS files was done using a WebGIS solution developed by the local team to visualize patients' home location, hospital locations, and travel routes.

8.6 Results

A total of 276 out of 1056 (26.1%) participants completed the survey; 150 of whom underwent mastectomy (54.3%) and 126 of whom underwent BCT (45.7%). Twenty-five (9%) of the participants completed the questionnaire via telephone.

8.6.1 Cohort Characteristics

The only significant difference in sociodemographic and geographical characteristics between women undergoing BCT versus mastectomy was in annual household income (Table 8.1). For clinicopathological factors, the mastectomy group had more advanced overall stage, tumor stage, tumor size, nodal stage, and higher pre-operative MRI rates (Table 8.2).

Table 8.1: Participant cohort characteristics

	Mastectomy (N=150) n (%)	BCT (N = 126) n (%)	p-value
Mean Age	58.9	59.6	0.64*
Age			0.15
<50	36 (24.0)	27 (13.5)	
50-65	62 (41.3)	64 (50.8)	
65-80	44 (29.3)	39 (31.0)	
>80	8 (5.3)	6 (4.8)	
Ethnicity			0.08

Caucasian	145 (96.7)	119 (94.4)	
First Nations, Metis, Inuit	0 (0.0)	4 (3.2)	
Other	5 (3.3)	3 (2.4)	
Annual Household Income			<0.01
< \$40,000	29 (27.4)	13 (14.6)	
\$40,000 – \$100,000	41 (38.8)	56 (62.9)	
≥ \$100,000	36 (34.0)	20 (21.5)	
Employment Status			0.95
Employed	65 (43.6)	55 (44.0)	
Not Employed	84 (56.4)	70 (56.0)	
Highest Level of education			0.26
Less than high school	10 (6.7)	8 (6.4)	
Completed high school	31 (20.7)	28 (22.2)	
Some technical or community college	14 (9.3)	11 (8.7)	
Completed college	46 (30.7)	24 (19.1)	
Some university	14 (9.3)	20 (15.9)	
Bachelor's degree	24 (16.0)	18 (14.3)	
Master's degree	5 (3.3)	7 (5.6)	
Professional degree or doctorate	6 (4.0)	10 (7.9)	
Smoking Status			0.94
Never	72 (48.0)	62 (49.2)	
Ex-smoker	66 (44.0)	53 (42.1)	
Current Smoker	12 (8.0)	11 (8.7)	
Relationship Status			0.69
In a relationship	120 (80.5)	103 (82.4)	
Not in a relationship	29 (19.5)	22 (17.6)	
Children			0.90
Yes	120 (86.0)	21 (14.0)	
No	109 (86.5)	17 (13.5)	
Menopausal Status			0.52
Pre-menopause	47 (31.3)	103 (68.7)	
Post-menopause	35 (27.8)	91 (72.2)	
Breast size			0.12
≤ A	15 (10.0)	3 (2.4)	
B	41 (27.3)	33 (26.2)	
C	38 (25.3)	35 (27.8)	
D	45 (30.0)	40 (31.2)	
E	5 (3.3)	4 (32.0)	

≥F	6 (4.0)	11 (8.7)	
Urban vs Rural Residence			0.34
Urban	85 (56.7)	78 (62.4)	
Rural	65 (43.4)	47 (37.6)	
City of Surgery			0.43
Saskatoon	79 (52.7)	62 (49.2)	
Regina	60 (40.0)	49 (38.9)	
Other	11 (7.3)	15 (11.9)	
Distance from Surgical Centre	107.4 km	101.3 km	0.79*

Note: denominators may vary depending on response rate.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

*Two tailed t-test was used for this analysis.

p-values listed used significance level of 0.05.

Table 8.2: Clinicopathological characteristics

	Mastectomy (N=150) n (%)	BCT (N = 126) n (%)	p-value
AJCC Stage			<0.01
I	69 (46.0)	85 (67.5)	
II	81 (54.0)	41 (32.5)	
Tumor Stage			<0.01
T1mic	6 (4.0)	2 (1.6)	
T1A	6 (4.0)	3 (2.4)	
T1B	24 (16.0)	35 (27.8)	
T1C	46 (30.7)	55 (43.7)	
T2	65 (43.3)	30 (23.8)	
T3	3 (2.0)	0 (0)	
Mean Tumor Size	2.0cm	1.6cm	<0.01*
Nodal Stage			0.036
N0	105 (70.0%)	102 (80.1%)	
N1	45 (45.0%)	24 (19.0%)	
Estrogen Receptor (ER) Assay			0.46
ER +	134 (89.3)	114 (90.5)	
ER -	16 (10.7)	10 (7.9)	
Progesterone Receptor (PR) Assay			0.27
PR +	122 (81.3)	107 (84.9)	
PR -	28 (18.7)	17 (13.5)	
HER2 Assay			0.32
HER2 +	13 (25.0)	5 (12.8)	
HER2 -	37 (71.2)	33 (84.6)	

Borderline	2 (3.8)	1 (2.6)	
Combination of ER, PR, HER2 Assays			0.07
Not favorable**	30 (20.8)	15 (12.4)	
Favorable	114 (79.2)	106 (87.6)	
Tumor Grade			0.07
Grade 1	31 (22.0)	34 (27.8)	
Grade 2	62 (44.0)	62 (50.8)	
Grade 3	48 (34.0)	26 (21.3)	
Tumor Description			0.42
Infiltrating Ductal	105 (70.0)	90 (71.4)	
Infiltrating Lobular	20 (13.3)	11 (8.7)	
Ductal & Lobular	6 (4.0)	3 (2.4)	
Mucinous Adenocarcinoma	6 (4.0)	4 (3.2)	
Other	13 (8.7)	18 (14.3)	
Tumor Multiplicity Counter			0.34
01	110 (79.7)	110 (87.3)	
02	16 (11.6)	9 (7.1)	
03	6 (4.4)	3 (2.4)	
>04	6 (4.4)	3 (2.4)	
Tumor Side			0.24
Left	81 (54.0)	59 (46.8)	
Right	69 (46.0)	67 (53.2)	
Tumor Location			0.02
Breast other***	112 (74.7)	77 (61.1)	
Upper-outer	38 (25.3)	48 (38.9)	
Pre-operative MRI			0.05
Yes	90 (60.0)	61 (48.4)	
No	60 (40.0)	65 (51.6)	

Note: denominators may vary depending on response rate.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

*Two tailed t-test was used for this analysis.

**Not favorable combinations: ER-/PR-/HER2-, ER-/PR-/HER2+, ER-/PR+/HER2+, ER+/PR-/HER2+, and ER+/PR+/HER2+.

Favorable combinations: ER+/PR+/HER2-, ER-/PR+/HER2-, and ER+/PR+/HER2-.

***Breast other: Breast not otherwise specified, central, lower-inner, lower-outer, overlap, and upper-inner.

p-values listed used significance level of 0.05.

8.6.2 Predictors of BCT Compared with Mastectomy

Results of the univariate logistic regression are presented in Table 8.3. The final model from multivariate logistic regression resulted in six significant factors influencing therapy choice

(Table 8.4). Stage of disease was the only clinicopathological factor; the remainder were individual belief and preference factors.

Table 8.3: Univariate logistic regression

	Univariate Odds Ratio	95% C.I.	p-value
Age			
<50	1.00	Referent	
50-65	0.46	0.23 – 0.90	0.02
65-80	0.53	0.26 – 1.09	0.09
>80	0.63	0.19 – 2.10	0.45
Ethnicity			
Caucasian	1.00	Referent	
First Nations, Metis, Inuit	N/A	N/A	N/A
Other	1.22	0.34 – 4.44	0.31
Annual Household Income			
< \$40,000		Referent	
\$40,000 – \$100,000	0.33	0.15 – 0.71	<0.01
≥ \$100,000	0.81	0.34 – 1.89	0.09
Employment Status			
Employed	1.00	Referent	
Not Employed	1.02	0.63 – 1.64	0.95
Highest Level of education			
Less than high school	1.00	Referent	
Completed high school	0.89	0.31 – 2.56	0.82
Some technical or community college	1.02	0.30 – 3.45	0.98
Completed college	1.53	0.54 – 4.39	0.43
Some university	0.56	0.18 – 1.77	0.33
Bachelor's degree	1.07	0.35 – 3.24	0.91
Master's degree	0.57	0.13 – 2.50	0.46
Professional degree or doctorate	0.48	0.12 – 1.90	0.30
Smoking Status			
Never	1.00	Referent	
Ex-smoker	1.07	0.65 – 1.76	0.78
Current Smoker	0.94	0.39 – 2.28	0.89
Relationship Status			
In a relationship	1.00	Referent	

Not in a relationship	1.13	0.61 – 2.09	0.69
Children			
Yes	1.00	Referent	
No	1.04	0.52 – 2.08	0.90
Menopausal Status			
Pre-menopause	1.00	Referent	
Post-menopause	0.84	0.50 – 1.42	0.52
Breast size			
≤ A	1.00	Referent	
B	0.25	0.07 – 0.93	0.04
C	0.22	0.06 – 0.81	0.02
D	0.23	0.06 – 0.85	0.03
E	0.25	0.03 – 1.52	0.13
≥F	0.13	0.03 – 0.57	0.02
Urban vs Rural Residence			
Urban	1.00	Referent	
Rural	1.27	0.78 – 2.06	0.34
City of Surgery			
Other	1.00	Referent	
Saskatoon	1.74	0.75 – 4.05	0.20
Regina	1.67	0.70 – 3.96	0.25
Distance from Surgical Centre	1.00	1.00 – 1.00	0.80
AJCC Stage			
I	1.00	Referent	
II	2.43	1.49 – 3.98	<0.01
Tumor Stage			
T1mic	1.00	Referent	
T1A	0.66	0.08 – 5.54	0.71
T1B	0.23	0.04 – 1.23	0.09
T1C	0.28	0.05 – 1.45	0.13
T2	0.72	0.14 – 3.79	0.70
Mean Tumor Size	1.04	1.02 – 1.07	<0.01
Nodal Stage			
N0	1.00	Referent	
N1	1.82	1.04 – 3.21	0.04
Estrogen Receptor (ER) Assay			
ER +	1.00	Referent	
ER -	1.36	0.59 – 3.12	0.47
Progesterone Receptor (PR) Assay			

PR +	1.00	Referent	
PR -	1.44	0.75 – 2.78	0.27
HER2 Assay			
HER2 +	1.00	Referent	
HER2 -	0.56	0.22 – 1.50	0.26
Combination of ER, PR, HER2 Assays			
Not favorable**	1.00	Referent	
Favorable	1.78	1.22 – 2.60	<0.01
Tumor Grade			
Grade 1	1.00	Referent	
Grade 2	1.10	0.60 – 2.00	0.76
Grade 3	2.02	1.02 – 4.00	0.04
Tumor Description			
Ductal & Lobular	1.00	Referent	
Infiltrating Lobular	0.75	0.11 – 4.90	0.76
Infiltrating Ductal	0.91	0.19 – 4.37	0.91
Mucinous Adenoca	0.58	0.14 – 2.40	0.46
Other	0.26	0.07 – 1.72	0.20
Tumor Multiplicity Counter			
01	1.00	Referent	
02	1.78	0.75 – 4.19	0.19
03	2.00	0.48 – 8.20	0.96
>04	2.00	0.48 – 8.20	0.96
Tumor Side			
Left	1.00	Referent	
Right	0.75	0.47 – 1.21	0.24
Tumor Location			
Breast other***	1.00	Referent	
Upper-outer	0.53	0.32 – 0.89	0.02
Pre-op MRI			
Yes	1.00	Referent	
No	0.3	0.39 – 1.01	0.06
Worry About Cancer Recurrence	2.75	2.12 – 3.33	<0.01
Age	1.20	0.99 – 1.46	0.06
Other Individual Medical History	1.14	0.94 – 1.37	0.19
Family History of Breast Cancer	1.34	1.10 – 1.64	<0.01
Previous Breast Disease	1.16	0.94 – 1.44	0.17
Breast Size	1.00	0.81 – 1.24	0.99

Tumor Size	0.61	0.50 – 0.75	<0.01
Travel Distance	1.08	0.85 – 1.38	0.51
Surgeon's Opinion	0.66	0.54 – 0.79	<0.01
Feminine Identity	0.63	0.51 – 0.79	<0.01
Sexuality	0.64	0.50 – 0.81	<0.01
Wanting to Keep Breast Tissue	0.31	0.23 – 0.42	<0.01
Incorporating Reconstruction	1.11	0.91 – 1.38	0.29
Total Treatment Time	1.24	1.00 – 1.54	0.05

Note: denominators may vary depending on response rate for each questionnaire item.

Univariate logistic regression was used to evaluate likelihood of mastectomy versus BCT unless otherwise specified. Higher odds favours mastectomy.

*two tailed-t-test was used for this analysis.

**Not favorable combinations: ER-/PR-/HER2-, ER-/PR-/HER2+, ER-/PR+/HER2+, ER+/PR-/HER2+, and ER+/PR+/HER2+.

Favorable combinations: ER+/PR+/HER2-, ER-/PR+/HER2-, and ER+/PR+/HER2-.

***Breast other: Breast not otherwise specified, central, lower-inner, lower-outer, overlap, and upper-inner.

p-values listed used significance level of 0.05.

Table 8.4: Multivariate logistic regression final model

	Multivariate Odds Ratio	95% C.I.	p-value
AJCC Stage			
I	1.00	Referent	
II	7.48	2.98 – 18.82	<0.01
Worry About Cancer Recurrence	3.44	2.32 – 5.11	<0.01
Tumor Size	0.66	0.47 – 0.94	<0.01
Surgeon's Opinion	0.69	0.50 – 0.96	0.03
Wanting to Keep Breast Tissue	0.17	0.10 – 0.30	<0.01
Total Treatment Time	1.81	1.19 – 2.75	<0.01

8.6.3 Clinicopathological Factors

In multivariate analysis only overall stage remained a significant factor; women who had stage two disease had 7.5 times the odds of undergoing mastectomy compared to those who had stage one disease. Among participants who rated 'tumor size' as an important influencing factor, the actual tumor size between groups was amplified (Table 8.5). In this subgroup, the mean tumor sizes for mastectomy and BCT participants were 2.5cm compared with 1.5cm, respectively.

Table 8.5: Participants rating 'tumor size' as an important factor influencing their choice of therapy – distribution by actual tumor size

	Mastectomy (N=68) n (%)	BCT (N = 96) n (%)	p-value
Mean Tumor Size	2.52cm	1.54cm	<0.01*
Tumor Stage			<0.01
T1mic	2 (2.9)	0 (0.0)	
T1A	1 (1.45)	3 (3.1)	
T1B	7 (10.3)	31 (32.3)	
T1C	13 (19.2)	39 (40.6)	
T2	42 (61.8)	23 (24.0)	
T3	3 (4.4)	0 (0.0)	

Note: denominators may vary depending on response rate or testing by the cancer centre.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

*two tailed-t-test was used for this analysis.

p-values listed used significance level of 0.05.

8.6.4 Individual Factors

8.6.4.1 Personal Belief and Preference Factors

In our final model, factors that were rated as significantly more important for mastectomy patients were worry about cancer recurrence and total treatment time (Figure 8.2). Factors that were significantly more important for BCT patients were 'wanting to keep own breast tissue', 'tumor size', and 'surgeon's opinion'. Individual belief factors for mastectomy (Figure 8.3) and BCT (Figure 8.4) participants are displayed in order of cumulative importance.

Figure 8.2: Personal beliefs and preference factors for mastectomy versus BCT participants

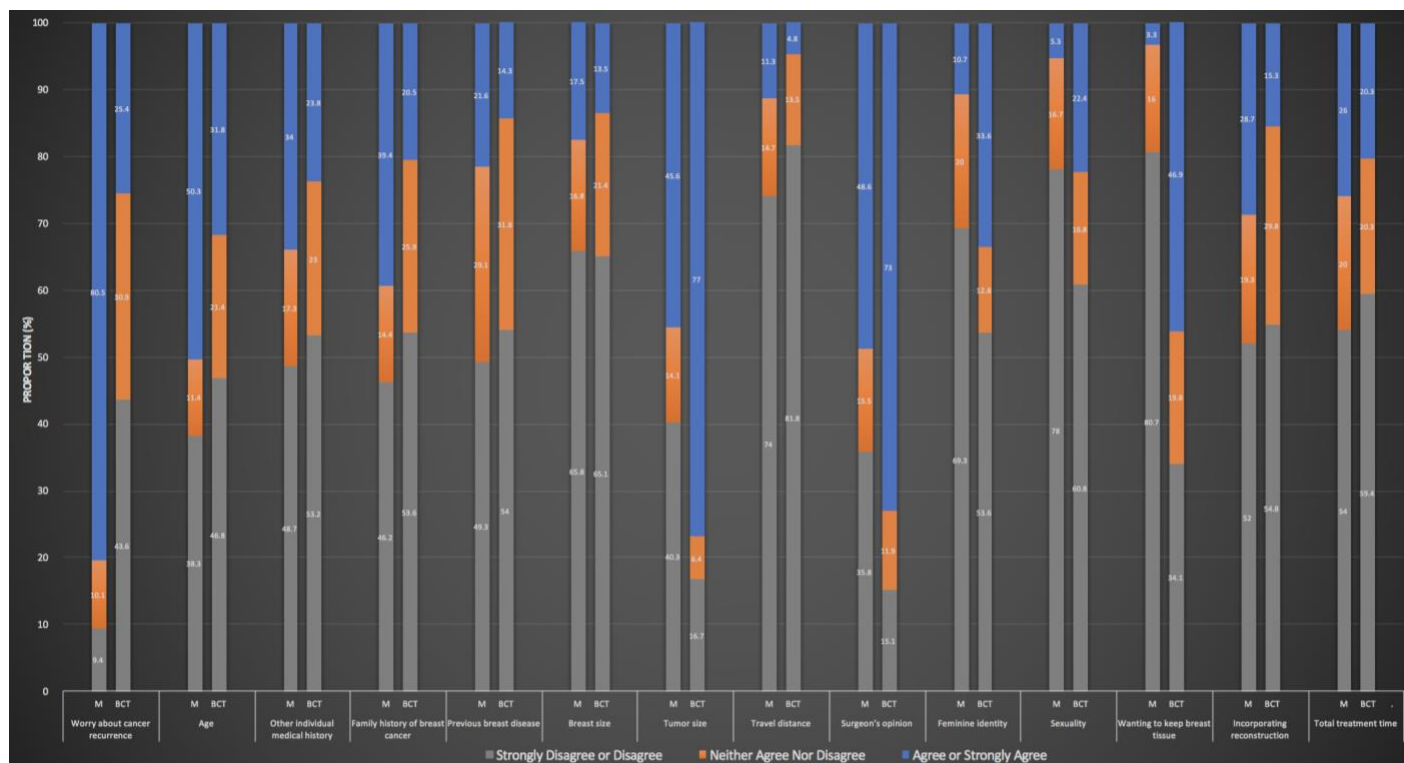


Figure 8.3: Personal belief and preference factors for mastectomy participants only

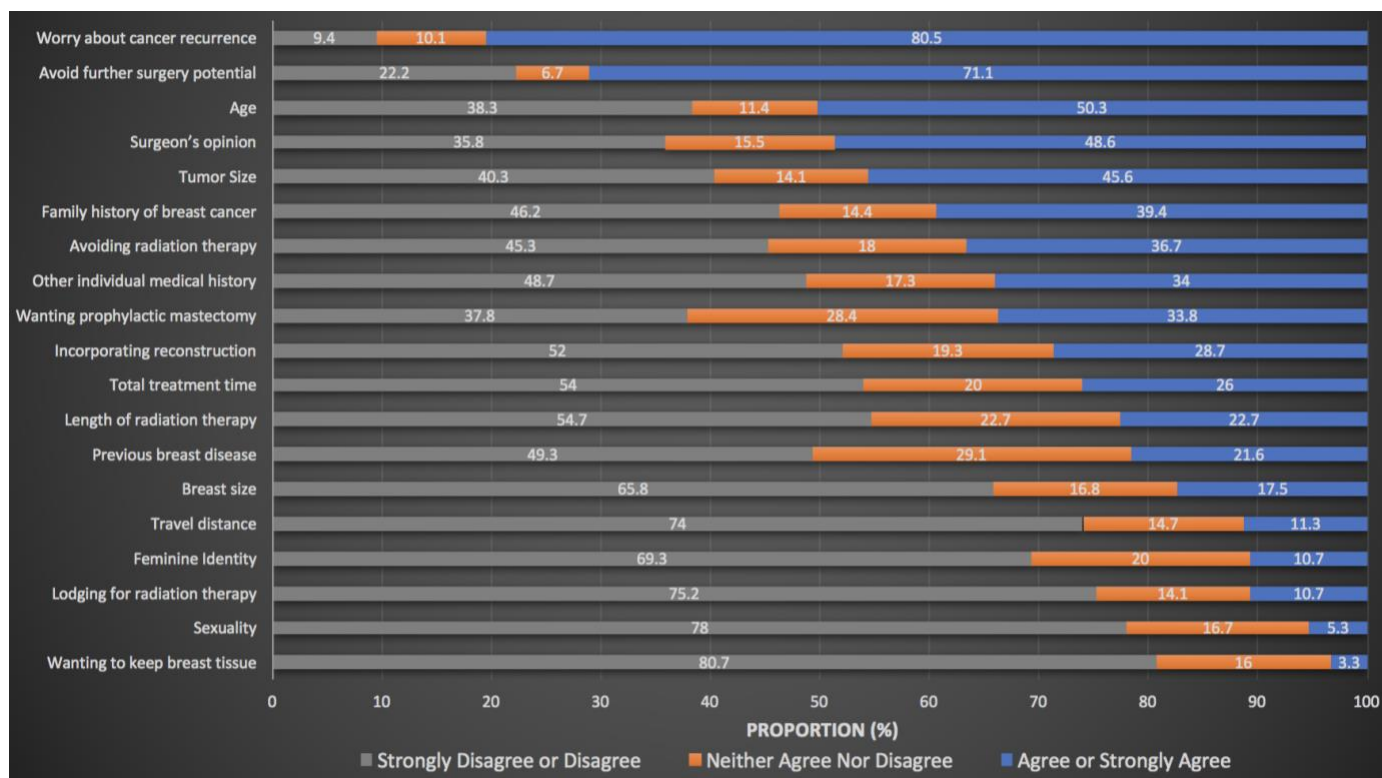
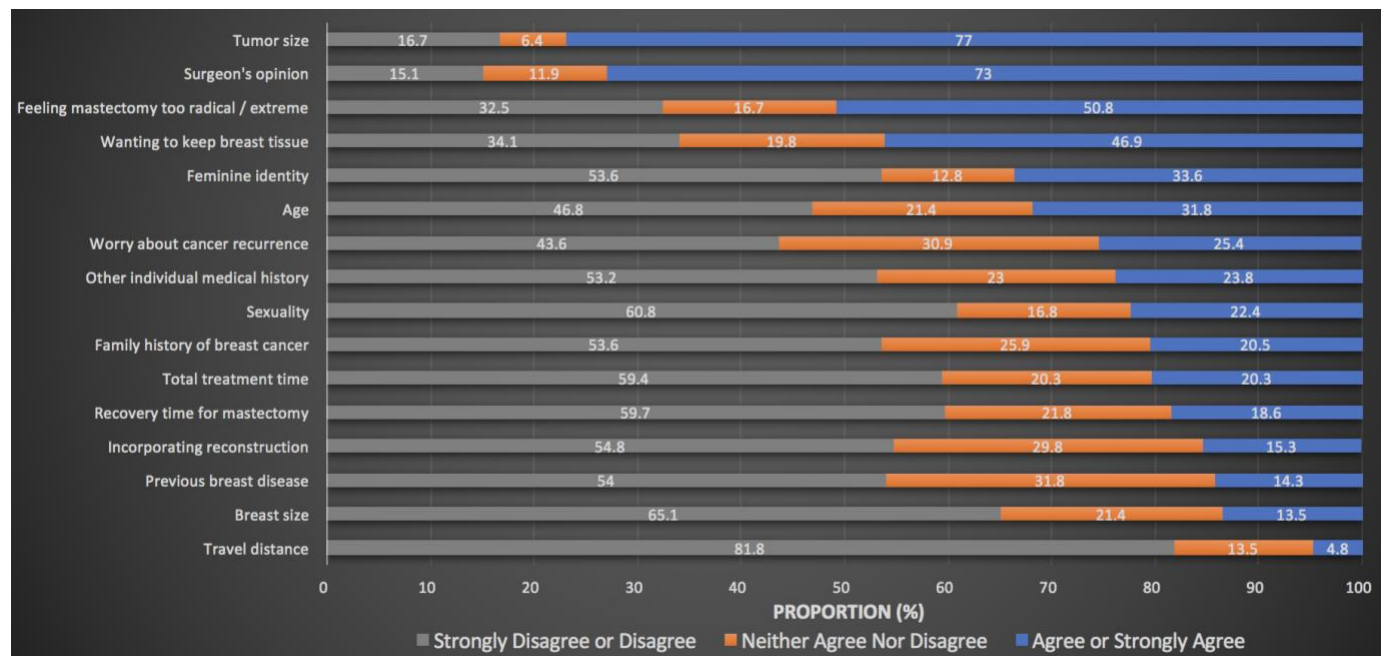


Figure 8.4: Personal belief and preference factors for BCT participants only



8.6.4.2 Sociodemographic Factors

No sociodemographic factors remained significant in our final main effects model.

8.6.4.3 Geographical Factors

The cohort as a whole did not demonstrate any significant geographical factors affecting treatment choice. Figure 8.5 depicts travel from patients' home residence to surgical centre. Figure 8.6 depicts BCT patients travel to one of two radiation centres in the province. In the mastectomy cohort, participants rating travel distance as important had a significantly higher mean distance to radiation centre – 195km versus 105km ($p < 0.01$). Figure 8.7 depicts mastectomy participants rating 'travel distance' as important and their distance to the nearest radiation centre.

Figure 8.5: GIS map of travel from home residence to surgical centre

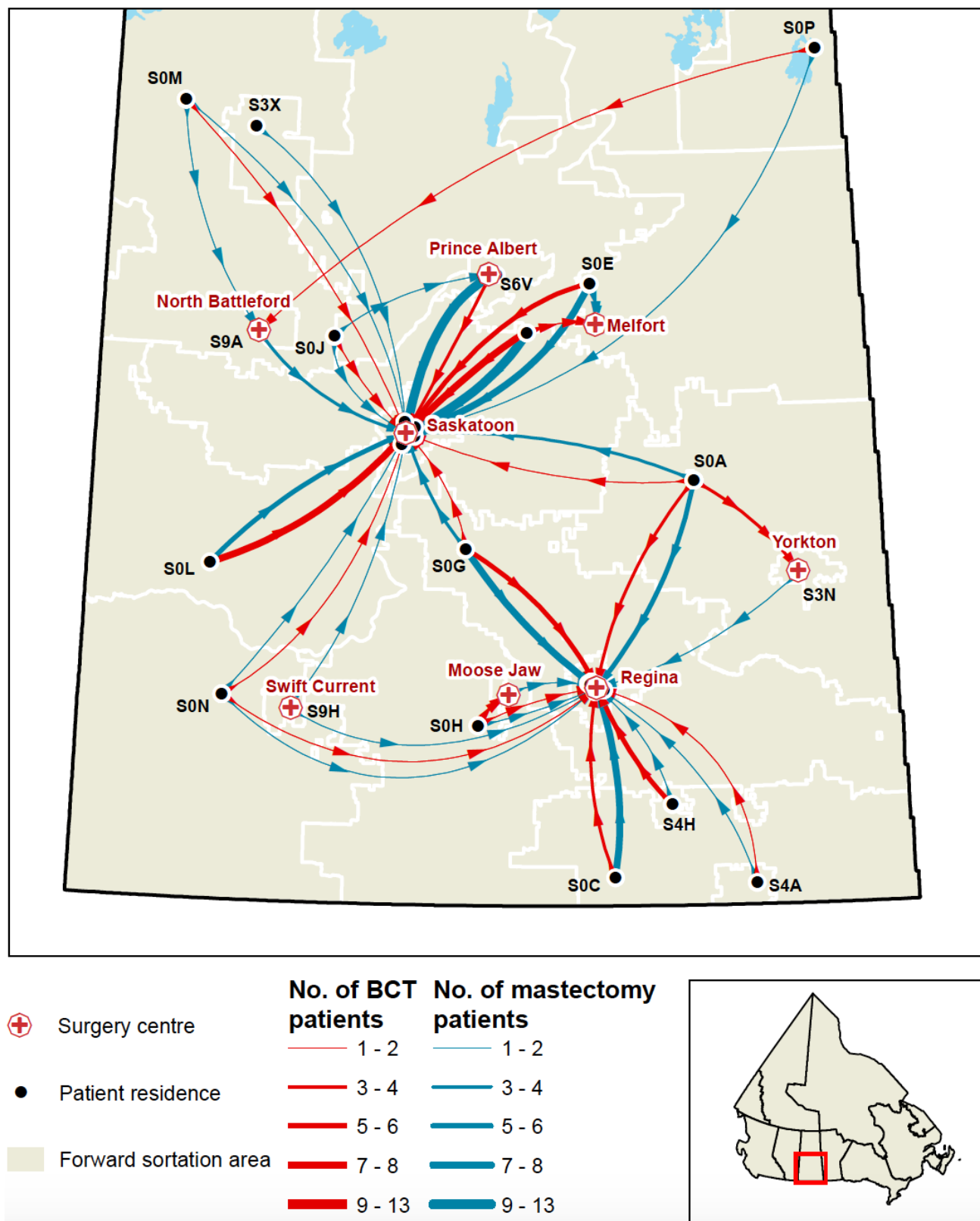


Figure 8.6: GIS map of BCT patients travel from home residence to radiation centre

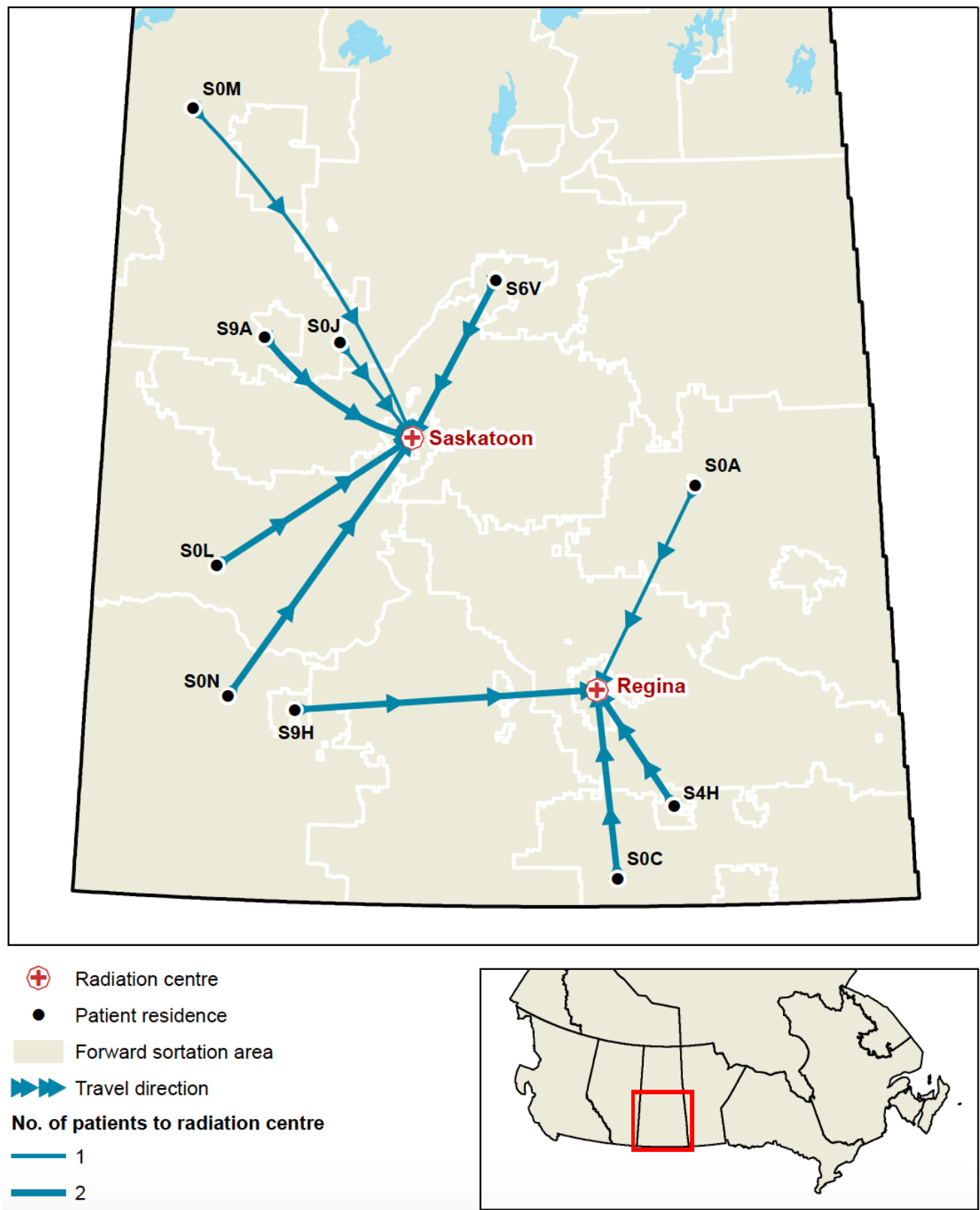
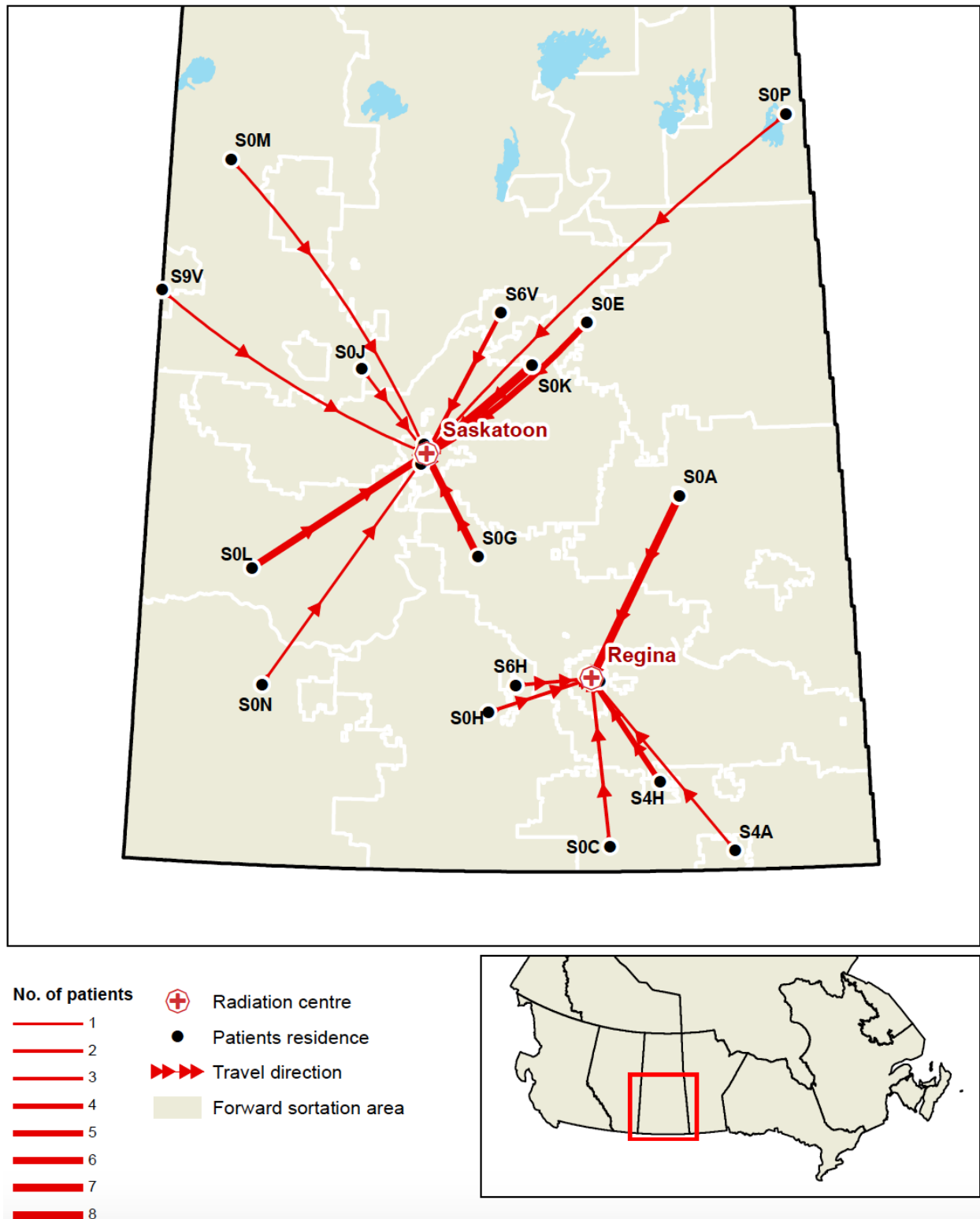


Figure 8.7: GIS map of mastectomy patients rating 'travel distance' as important and the travel from home residence to the nearest radiation centre



8.6.5 Physician Factors

Women who made the treatment decision completely on their own were more likely to undergo mastectomy (Table 8.6). Conversely, when the decision was shared or mostly the physician's choice, participants were significantly more likely to undergo BCT.

Table 8.6: Involvement in treatment decision-making process

	Mastectomy (N= 150) n (%)	BCT (N = 126) n (%)	Odds Ratio	95% C.I.	p-value
Involvement in Decision Making					
Completely your choice, no physician input	30 (20.0)	8 (6.5)	1.00	Referent	
Mostly your choice, minimal physician input	51 (34.0)	32 (25.8)	0.43	0.17 – 1.04	0.06
Shared decision	47 (31.3)	57 (45.9)	0.22	0.09 – 0.52	<0.01
Mostly your physician's choice	13 (8.7)	20 (16.1)	0.17	0.06 – 0.49	<0.01
Completely physician's choice, no individual input	9 (6.0)	7 (5.7)	0.34	0.10 – 1.21	0.10

Univariate logistic regression was used to evaluate likelihood of mastectomy versus BCT. Higher odds favours mastectomy. p-values listed used significance level of 0.05.

8.6.6 Moderating Effects of Disease Stage with Surgeon's Opinion and Disease Stage with Subjective Tumor Size

There were two significant interaction terms in our model: stage of disease with surgeon's opinion and stage of disease with subjective tumor size (Table 8.7). Participants' stage of disease, whether stage one or two, moderated the effect of tumor size as an important influence on treatment choice (Figure 8.8). Of participants who rated 'tumor size' as important to their treatment choice, those who had stage one disease were significantly more impacted by their subjective tumor size compared with those who had stage two disease. Women who had stage one disease and who also placed more importance on tumor size were twice as likely to undergo BCT (OR, 0.48; 95% CI, 0.29 – 0.82).

A similar relationship was observed between earlier stage of disease and surgeon's opinion (Figure 8.9). For participants who valued 'surgeon's opinion' on their therapy choice, those who had stage one disease had significantly more impact on their treatment choice as compared with those who had stage two disease. Women who had stage one disease and who placed more value on 'surgeon's opinion' were also more than twice as likely to undergo BCT (OR, 0.44; 95% CI, 0.26 – 0.75).

Table 8.7: Moderating effects of disease stage on 'surgeon's opinion' and disease stage on subjective 'tumor size' for mastectomy versus BCT

Stratum Specific Adjusted Odds Ratios, C.I.'s, and p-values						
	Stage 1 OR	95% C.I.	p-value	Stage 2 OR	95% C.I.	p-value
Tumor Size	0.48	0.29 – 0.82	<0.01	0.87	0.54 – 1.39	0.56
Surgeon's Opinion	0.44	0.26 – 0.75	<0.01	1.14	0.73 – 1.77	0.57

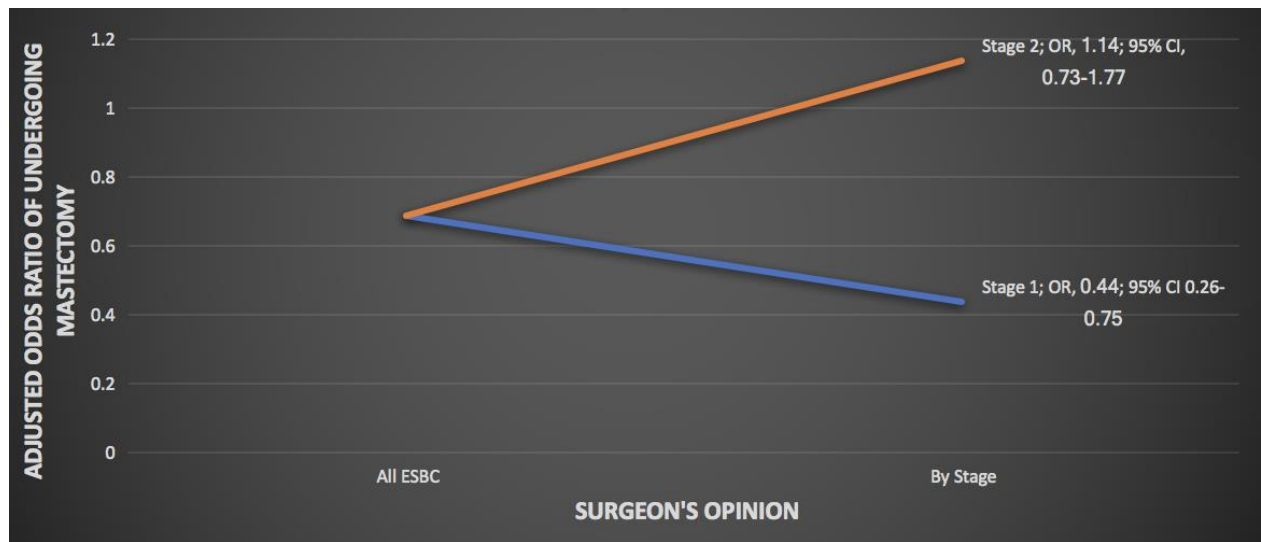
Univariate and Multivariate logistic regression was used to evaluate likelihood of mastectomy versus BCT. Higher odds favours mastectomy.

p-values listed used significance level of 0.05.

Figure 8.8: Moderating effects of disease stage with 'tumor size' for mastectomy versus BCT



Figure 8.9: Moderating effects of disease stage on 'surgeon's opinion' for mastectomy versus BCT



8.7 Discussion

The choice of mastectomy versus BCT is a complicated decision-making process that is influenced by a wide array of factors. Our study demonstrates that treatment choices for Saskatchewan women who had ESBC were primarily influenced by tumor stage and individual belief factors. These findings suggest that women are making their treatment choices predominantly based on individual values and preferences.

Later stage of disease, as determined by tumor size in cases of ESBC, was a significant factor influencing women to undergo mastectomy. This association has consistently been demonstrated in the literature.(121) Although both choices of treatment should be offered, patients who have larger tumors may subjectively believe that their breast cancer is more advanced, subsequently influencing their decision-making towards mastectomy. Additionally, larger tumors can result in worse cosmetic outcomes, and the breast-tumor ratio has been reported to affect treatment choice.(86) Larger tumors may also bias the physician towards recommending mastectomy, as they have been associated with higher re-excision and local recurrence rates.(23,77-79)

An interesting finding from our study was the effect modification that clinical stage had on the subjective 'tumor size'. When considering the impact of tumor size on treatment choice, a smaller tumor might be expected to influence towards BCT choice and a larger tumor to influence towards mastectomy. This was true for women who had stage one disease, among whom the value placed on tumor size significantly influenced their treatment towards BCT, but for women who had stage two disease, the value placed on tumor size did not have a significantly influence on therapy choice. These findings suggest

that tumor size, especially of smaller tumors, is an important reason women choose BCT but is less important for women who undergo mastectomy.

Socioeconomic status (SES), or indicators of SES, has been associated with increased likelihood of BCT, although most research is U.S.-based and thus has insurance as a complicating factor.(121) Considering that our study was conducted in a universal healthcare system, we did not expect to find this association. SES indicators including employment status, relationship status, children, urban versus rural residence, and highest level of education were not different between groups in our study. There was a discrepancy in income between the BCT and mastectomy groups in univariate analysis, with the middle-income range being more likely to have undergone BCT, but income was not significant in the multivariate analysis when controlling for disease stage. This finding suggests that differences in income between groups were incidental findings or reflect a lack of power. An alternate explanation is that groups having differing SES also have differences in health literacy or cultural norms, leading to differences in personal beliefs that were not captured by our survey questions.

There have been mixed results in the literature regarding the effect of rural residence and travel distance to radiation facilities on mastectomy rates, but more studies have shown decreasing BCT rates with increasing distance to treatment centres.(121) In our study, distance to treatment centres and urban versus rural residence did not affect treatment choice except for the subset of participants who rated travel distance as an important factor influencing mastectomy choice. Their mean travel distance to surgical and radiation facilities was significantly farther than for other mastectomy participants, indicating that although distance to treatment centre does not affect most individuals'

treatment choice, distance is a concern for a subset of. We have identified and mapped (Figure 8.7) the postal code regions of these patients and have fed this information back to the SCA and breast units. It is important to identify these individuals and emphasize the local supports in place to address geographical barriers. Locally, our cancer centre offers lodging during radiation treatments and shorter-course radiotherapy regimes. All efforts should be made to provide these supports to patients so that geographical constraints do not limit implementation of patients' therapy choice.

In our final model, patients who rated 'worry about cancer recurrence' and 'total treatment time' as important had increased odds of undergoing mastectomy. Worry about cancer recurrence has consistently been reported in the literature as the most common belief factor influencing the choice of mastectomy.(121) Our previous qualitative study also found it to be a primary theme motivating mastectomy choice, always for a secondary underlying reason: family history of breast cancer, prior observation of a poor BCT outcome, or desire to avoid follow-up imaging.(86) Interestingly, follow-up questions about why women rated worry about cancer recurrence as important indicated that family history was the most common reason. Patients who exhibit increased concern about recurrence because of family history are justified in doing so, as risk of developing a second breast cancer is increased in such instances(127). Health care providers must focus on appropriate education and counselling regarding relative risks and treatment options for these patients.

For belief factors influencing the choice of BCT, 'tumor size', 'surgeon's opinion', and 'wanting to keep breast tissue' were significant in our multivariate model. As noted in the earlier discussion, the effect of the tumor size on BCT choice is predominantly when the

tumor is small; this is logical as a small tumor may convey to the patient a sense that the disease is caught early and does not require a more extensive operation. Wanting to keep breast tissue was the strongest associated belief factor with undergoing BCT in our study (OR, 0.17; 95% CI, 0.10 – 0.30), in line with previous literature demonstrating breast tissue, body image concerns, and / or feminine identity as being the most important belief factors influencing BCT.(121)

Previous literature on physician-related factors has largely focused on physician demographics such as gender, age, type of training, and practice pattern.(121) Evaluating these factors was impractical in our study, which involved more than twenty surgeons from eight different surgical centres in Saskatchewan. Instead, we focused on the patients' perceptions of their interactions with their physician and their perceived influence on therapy decision-making. In our survey, those rating 'surgeon's opinion' highly had significantly increased odds of having BCT. This same relationship has also been demonstrated by local and other research.(86,121,128) The resulting directional relationship likely indicates that BCT, when possible, is thought by physicians to be better for the patient and is thus promoted as such. Some authors have even suggested that the use of mastectomy rates as a quality indicator may actually bias the physician treatment against patients' wishes.(88) In our own study, decision conflict scores were lower in the mastectomy group (19.8 versus 25.2; $p = 0.02$). Additionally, when participants were asked to reflect on their involvement in the treatment decision-making process (Table 8.5), women who made the treatment decision completely on their own were more likely to undergo mastectomy. Conversely, when the decision was shared or mostly the physician's choice, participants were significantly more likely to undergo BCT. These findings indicate

that patients undergoing mastectomy are more confident of their treatment choice and less likely to involve the physician's opinion.

Another interesting result from our study was the effect modification that clinical stage had on the 'surgeon's opinion' as an influential factor. For women who had stage one disease, the value placed on the surgeon's opinion significantly influenced their treatment decision towards BCT. However, for women who had stage two disease, value placed on the surgeon's opinion did not significantly influence on therapy choice. These findings suggest that the physician is more likely to influence the patient towards choice of BCT in cases of stage one disease but is less likely to be a significant influence in therapy choice in cases of stage two disease.

A limitation of our study is that most of our survey participants were Caucasian females. Approximately 16% of Saskatchewan's population who identifies as Indigenous (First Nations, Metis, or Inuit).(129) Our survey did not adequately sample this group; future targeted research strategies will be required to understand decision-making amongst this ethnic group. What's more, the response population did not reach our goal sample size, which could affect the reliability and generalizability of our results. A strength of our study was the grounding of the survey in a clinical framework to help guide and organize the study design and analysis. To the authors' knowledge, no previous studies on decision-making for ESBC have done so. We believe that organizing our survey around this framework allowed us to more holistically examine the factors influencing therapy choice than we could have done by simply investigating a subset of these domains. Furthermore, questionnaire development was, in part, directly informed by a previous exploratory work

within the province, which improved the relevance and depth of understanding of the personal belief factors.

8.7 Conclusions

The choice of mastectomy versus BCT in ESBC is a complicated decision-making process that is influenced by a wide array of factors. As research evaluating this topic grows in its comprehensiveness, we are gaining a better understanding of the importance of many individual belief factors driving therapy choice. If patients are choosing mastectomy predominantly because of values they hold and out of individual preference, a lower rate of BCT should not be of concern. We would advise against the use of mastectomy or BCT rates as an indicator of quality of care in the future. Instead, attention should be shifted towards care that is patient-centered. For physicians, this means patient education, understanding patients' views and preferences towards treatment, understanding their own treatment biases, engaging in a shared decision-making process, and facilitating the patient's treatment goals. From a quality improvement viewpoint, attention should be focused on identifying and limiting barriers to treatment options, including by identifying patients who have travel barriers and ensuring that they are aware of local supports or by ensuring that therapy choices are offered to patients.

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CHAPTER 9: DISCUSSION AND CONCLUSIONS

9.1 Introduction

The general aim of this thesis was to better understand the choice of treatment between breast conservation therapy and mastectomy in the setting of early stage breast cancer in Saskatchewan. More specifically, this thesis is rooted in two questions. Why are Canadian interprovincial mastectomy rates are so different, to the degree that Saskatchewan's mastectomy rate is consistently 20% higher than the national average? More importantly, does this difference reflect discrepancies in quality of care relating to treatment or how women are exercising their therapy choices?

Broadly, this research improved our understandings of this complicated decision-making process, led to the creation of a conceptual framework that better organizes a wide array of influencing factors, and has identified the ways in which many of these factors can interact with one another. In answering the specific questions that inspired this research, this work has produced important results, making Saskatchewan one of only two provinces in the nation to have been the subject of in-depth research investigating the factors underlying the choice between mastectomy and BCT. Concisely, choice of therapy was primarily influenced by disease stage and individual belief factors, which is in line with viewing this decision-making process as preference-sensitive care. These results also suggest that the mastectomy rate in Saskatchewan does not reflect a quality of care issue. Furthermore, with increasing research into and more in-depth understanding of this complicated decision-making process, we can better appreciate the importance of different

individual belief factors driving patients' therapy choice. These findings suggest that the use of BCT or mastectomy rates as quality of care indicators should be avoided and the focus shifted instead towards care that is more patient-centred.

9.2 Using a Framework to Guide Clinical Research

When the topic of research is complicated and influenced by multiple factors, such as when seeking to understand why women choose mastectomy compared to BCT, study design and results can vary greatly in the literature. This is not surprising, for researchers seek to integrate social, psychological, biological, and individual factors, as well as their interactions with the physicians and health care systems, in an attempt to understand how individuals make their therapy choice. A large body of literature has explored these factors for decision making in ESBC, but rarely has the research holistically incorporated the various factors. In fact, most individual studies have focused on a single set of factors such as tumor or geographical factors without considering other important influences, such as individual patient preferences.

One of the valuable contributions of this thesis has been the creation of a conceptual framework, as well as the emphasis that placed on such framework's importance for guiding research, especially when the topic of inquiry is complex. Compared with other fields, clinical medicine has lagged behind both in understanding the value of frameworks to guide inquiries and in using them to improve the quality of research. The primary purpose of a framework is to understand the phenomenon of interest in a more complete fashion by identifying and organizing important constructs logically.(110) If more clinical research were grounded in a framework, results would be less likely to overlook potentially

significant confounding factors, allowing for better interpretation and integration of results across the field of health care.

Chapter 6 presents the development of our conceptual framework, illustrating the central domains that influence women's choice between mastectomy and BCT in cases of ESBC (Figure 6.1). These have been organized into three broad constructs: clinicopathological factors, physician factors, and individual factors with subgroups of sociodemographic, geographic, and individual belief factors. Although this framework was developed specifically to examine the factors influencing a patient's therapy choice in the setting of ESBC, it amply demonstrates the benefits of using a framework to guide clinical investigation for any field.

Our framework was used to organize the literature review –the first and only published systematic review to have examined why women who have ESBC chose mastectomy compared with BCT. Full details of this review are presented in Chapter 3. The framework also provided the foundation of how we developed our survey; the key constructs were used to organize all stages of the survey study including conceptual development and specific ordering of survey items, guiding the analysis, and enriching the interpretation and discussion. Full details of the surveys' development are presented in Chapter 7 and the results of the survey are presented in Chapter 8.

In reflection, creation and use of our conceptual framework has greatly benefited the quality of the systematic review and the survey phase of this research. It aided in organizing the multiple influencing factors into key underlying constructs, and in doing so, allowing us to conduct research in a more complete fashion. Furthermore, it provided a consistent and logical basis of thinking for critically reviewing a complex topic – that of why

women choose mastectomy compared with BCT. This benefited and improved our research not only in one manuscript but throughout the thesis itself.

9.2.1 Reflection on the Theory of Planned Behavior

Chapter 2.4 introduces the TPB and presents its' application to conceptualizing the choice between mastectomy versus BCT as a planned behavior. At a theoretical level, potential decision-making factors can be applied to one or more of the key TPB constructs – attitude towards the behavior, subjective norm, or perceived behavioral control. For example, fear of cancer recurrence can be explained by behavioral beliefs and surgeons' influence or recommendations can be explained by individual norms. The application of the TPB to these factors, along with other influences on decision-making, is presented in Figure 2.7.

Certainly the TPB was important in guiding the thematic analysis of my qualitative research. This theory provided a basis for conceptualizing and organizing codes into initial candidate themes and candidate concept maps. These maps subsequently provided the basis for refining themes and evaluating their associations to produce the final thematic maps. Full description of this process is detailed in chapters 4.2.2 and 5.5.

Although the TPB is logically sound and is useful for conceptualizing decision-making influences at an individual level, there is a gap in translating findings when applying the TPB to broader clinical investigations. It is impractical for most clinicians to view factors theoretically as subjective norms or perceived behavioral control. Recognizing the incongruence between theory and clinical application was a significant motivator for creation of our own framework that would better fit the research goals. In summary, the TPB was useful in my initial research and played an important role in leading up to creation

of the framework but in this research context has limited clinical application at a broader level.

9.3 Strengths and Limitations

Overall, the strength of our research lies in the multiple methodologies employed and in how each phase complements another to support our pursuit of research objectives. Chapter 9.2 details how the creation, publication, and emphasis of the clinical framework we developed was a strength of our research.

The absence of any previous systematic reviews on this topic motivated our group to conduct the first systematic review of why women who have ESBC choose mastectomy compared with breast conservation therapy. This review provided a rigorous synthesis of factors that was not previously available in the literature. It was also a foundation for assessing the current state of knowledge relating to our research topic and thus benefited the other phases of study.

Our research followed an exploratory sequential mixed methods design, which is another strength of our investigations. A primary goal of our research was to identify factors that influenced Saskatchewan women's decision-making and to understand how these factors influenced their therapy choice. We understood by reviewing the literature and conducting a systematic review that this was a complicated topic and that many previous publications had inadequately studied treatment decision-making by missing large categories of influencing factors. Although doing so would be more time and resource intensive, we felt using a combination of qualitative and quantitative approaches as better enabling us to investigate and understand the full extent of factors that influence therapy choice than with any single approach alone could.

No previous research evaluating why women who had ESBC chose mastectomy compared with BCT had been conducted in Saskatchewan in the past. We were thus not sure whether the same factors noted in the literature applied to Saskatchewan women. The initial qualitative study was aimed at identifying factors that influenced therapy choice within our population of interest. These findings subsequently directly guided the creation of our questionnaire, which targeted individual preferences and values. Because the questions were grounded on the Saskatchewan patients and their perspectives, specific questions, terminology, wording, and follow-up questions were based on our initial qualitative study. The use of an in-depth questionnaire design and specific response options is a strength of our study.

Another strength of our survey was its design to capture all major influencing constructs: clinicopathological, physician, and individual with subgroups of sociodemographic, geographical, and personal belief factors. As previously discussed, this has rarely been featured in the literature – not entirely surprisingly, as capturing factors from all three constructs is both resource-intensive and procedurally complicated. Nevertheless, it seemed important, when interpreting results of a study, to consider the potential for significant confounding were a construct to be ignored altogether.

Limitations of our research include capturing a representative sample of our target population, being retrospective in design, the response rate, and response bias. Approximately 16% of Saskatchewan's population identifies as Indigenous (First Nations, Metis, or Inuit).(129) Unfortunately, we did not adequately sample this population in our qualitative study or our survey. In our qualitative study and survey, we had 1(4%) and 4(1.5%) Indigenous participants respectively. Most participants in our research were

Caucasian females – 92% in the qualitative study and 95.6% in our survey. Future dedicated research strategies will be required to understand why women of Indigenous ethnicity make their treatment choices.

Another limitation was the response population not reaching our intended sample size, potentially affecting the reliability and generalizability of our results. Another limitation of our research is the retrospective design, which included the potential for recall bias's and post-treatment experiences' affecting participant responses. It is possible that patients reported their decisions based on post hoc justification instead of citing the reasons important at the time of decision-making. This also poses a potential problem for recalling the details of information presented around the time of treatment choice, for research has previously identified that patients' recall of events surrounding cancer diagnosis can be problematic.(108,109)

Our final survey included 276 participants, for a 26.1% response rate – lower than our initial goal of 45%. This shortfall gives rise to potential study limitations, including the generalizability of our results to the larger Saskatchewan population. We must also consider how potential nonresponse bias could affect our outcomes. Although we would like to believe that the general findings from our study are likely to remain the same with improved recruitment, differences in outcome would certainly be possible with improved response.

There are multiple potential reasons for the low response rate in our study. Invitations to participate were mailed out from December 2017 to April 2018, but patients' cancer treatments had been between 2014 to 2015. This potential four-year gap between diagnosis and recruitment might have seen patients move out of province or suffer an

adverse event that rendered them unable to respond. What's more, the invitation period came during a time of year when many Saskatchewan residents act as 'snowbirds'.

Limitations of technology and computer literacy could also be to blame. The primary modality of survey response was via an online survey and although we offered a phone-interview option, the mere presence of an online-survey option might have been enough to deter some participants.

Future research with more prospective methods may be warranted to address some of the limitations of our current research. For example, all patients in Saskatchewan who were diagnosed with ESBC could be prospectively tracked over a one- year period for potential study recruitment. These patients could be invited to participate during their cancer clinic visits and could be provided with options for computer, tablet, or paper survey responses. This would likely improve recruitment of a representative population, alleviate the potential limitations of recall bias, and improve the study's response rate.

9.4 Other Research Within Canada

9.4.1 Newfoundland and Labrador

As far I am are aware, only one other Canadian province, Newfoundland and Labrador, has been the site of research into why women choose mastectomy compared with breast conservation therapy.(130) It is interesting to note that in the latest 2015 CPAC report, Saskatchewan's mastectomy rate has been second to only that of Newfoundland, which has had the nation's highest final mastectomy rate of 68.3%.(27) Their research team has conducted parallel qualitative and quantitative studies.(131,132)

The quantitative study by McCrate et al was published in October of 2018 in the *Canadian Journal of Surgery* and entitled 'Surgical treatment choices for breast cancer in Newfoundland and Labrador: a retrospective cohort study'.⁽¹³¹⁾ This is a retrospective cohort examined all women diagnosed with breast cancer over a six-year period from January 2009 to December 2014. Included participants were not only those who had ESBC, stage one and two breast cancer, but also those who had pre-invasive cancer, stage 0 or ductal carcinoma in situ, or advanced breast cancer, stage three or four breast cancer. Diagnostic data from the Newfoundland and Labrador provincial tumor registry were linked with surgery data from the Discharge Abstract Database of the CIHI. The variables included in the study were: year of diagnosis, age at diagnosis, stage at diagnosis, geographic code of residence, health regions at diagnosis, and surgical procedure performed. Driving time between patient residence to the radiation centre in St. John's was calculated using the road distance database maintained by the Economic and Statistics Branch of the government. Statistical analysis was performed using univariate and logistic regression modelling.

Their final study cohort included 2,346 cases, in 1,605 (68.4%) of which the patient underwent mastectomy. Patients' mean age of diagnosis was 61 years. Distribution of disease by stage was as follows: stage zero (13.9%), stage one (40.5%), stage two (30.6%), stage three (11.8%), and stage four (2.9%). In their final multivariate model, the two significant predictors of mastectomy were stage at diagnosis and driving time. Women were 1.82 times [95% CI, 1.64-2.02] more likely to have mastectomy for every unit increase in stage from 0 to 4 and 1.15 times [95% CI, 1.11-1.21] more likely to have mastectomy for

every unit of driving time increase. Driving units or 30 minutes were divided into eight categories, from 30 minutes or shorter to 540 minutes or more.

A qualitative study by Dicks et al. was published in April of 2019 in *Current Oncology*, and entitled 'Factors influencing surgical treatment decisions for breast cancer: a qualitative exploration of surgeon and patient perspectives.'(132) This study followed a descriptive qualitative design focused on better explicating the factors influencing breast cancer surgical decision-making. Data collection included interviews and focus groups with thirteen surgeons and thirty-five women who were offered the choice of BCT or mastectomy. Their analysis using qualitative description to summarize the data pertaining to surgical decisions.

The researchers' final sample of women included four women who had BCT as their final treatment, and thirty-one patients who had mastectomy as their final treatment. In their descriptive findings, the authors noted that both physicians and patients recounted numerous factors influencing their decisions including clinical, demographic, psychosocial, education-related, and cultural.(132) Surgeons in particular recognized the high rate of mastectomy in the province and this was in keeping with a rising rate of CPM. For women, they found a key factor was fear of recurrence and a need to 'just get rid of it', but other experiences also influenced their decision. Other important influences noted included body image, life stage and family considerations.

9.4.2 Comparison of Newfoundland and Labrador with Saskatchewan

We first compare and contrast the quantitative study by McCrate et al. with ours.(131) Broadly, there are some important differences in study design compared with our own research. A major difference is the inclusion of all types of breast cancer, including

DCIS, which is non-invasive breast cancer, and advanced breast cancer, stage three and four cancer, while our study focused only on stage one and two disease. A second major difference is their study used database and registry information, which limited the variables they were able to collect. Of the clinicopathological factors, only stage was reported. Of the individual factors, only age and geographical factors were reported. There were no physician factor data.

The province of Newfoundland has only one radiation treatment facility located in St. John's. As with much of Canada, the landmass-to-population ratio presents challenges in having advanced facilities without some geographical limitations for those living in rural communities. In Saskatchewan, when we examined our cohort as a whole, we found no significant geographical factors affecting treatment choice including urban versus rural residence, city of surgery, and average distance from surgical centre. Only when we further examined the participants who valued 'travel distance' as an influential factor did the seventeen (11.3%) mastectomy and six (4.7%) BCT participants demonstrate a significant difference in mean travel distance between groups. In Newfoundland, they reported increasing likelihood of undergoing mastectomy with each forty-minute increase in driving time. However, the manuscript did not provide important pieces of information, including whether there are any supports in place to aid patients who have long travel distances, such as subsidized lodging or variations in radiation regimens. It would also be important to know how this information is being offered to the patients, and what is being done to maximize patients' ability to have the treatment option of their choice.

Another significant predictor in the Newfoundland study was increasing stage of disease. However, Newfoundland's rate of mastectomy for stage one and stage two disease

was quite high compared with Saskatchewan's – 64% for stage one disease, compared with 44.8% in Saskatchewan, and 73.5% for stage two disease, compared with 66.4% in Saskatchewan. Potential explanations afforded in their discussion were tumor characteristics factors and the potential for their province to have a higher incidence of inherited disorders. Considering that the stage incorporates tumor factors, unaccounted for tumor characteristics are an unlikely explanation for the mastectomy rate. It is possible, however, that Newfoundland has higher rates of BRCA – but if so, this information should be incorporated into their research, for management for BRCA differs from that of regular-risk ESBC.(25) In the 2015 CPAC report, Newfoundland also had the nation's largest change from index to final mastectomy rate at 54.2% to 68.3%.(27) Although this could be related to higher rates of open biopsy, assessment of positive margin rates after lumpectomy would be important to evaluate so as to ensure a high standard of surgical care.(133)

Overall, our main caution in interpreting results from McCrate et al. is the lack of consideration for other important influencing factors affecting patients' therapy choice, especially personal preference and physician factors. Our study in Saskatchewan also found that stage of disease was an important factor in increasing the likelihood of undergoing mastectomy, but the majority of significant influencing factors were personal preference factors – worry about cancer recurrence, total treatment time, wanting to keep own breast tissue, and surgeon's opinion. We recognize that capturing personal preference factors is logistically more challenging and resource-intensive, but it is becoming clear that these are important influences that must be evaluated when seeking to understand the 'surgical treatment choices' that patients are making. We would also suggest using a framework to guide future research, as doing so has greatly aided us in our own work.

In comparing and contrasting the qualitative study by Dicks et al with our own, the major differences are inclusion of physicians in their working group as well as a large discrepancy of mastectomy to BCT participants sampled in their study.(132) Dicks et al. reported that physicians in Newfoundland were specifically aware of the high rate in the province – potentially, the researchers noted, in conjunction with rising CPM rates. We are aware of other Canadian literature that has demonstrated increasing CPM rates,(134) but did not find this to be a significant factor in choice of therapy in our province. CPM seems more likely to be related to the underlying influence of choice of mastectomy rather than to be the source of influence for women’s choice of mastectomy. There is some concern in interpreting the influences of women undergoing BCT, as only four participants were included who had BCT as their final procedure – which poses a risk of under sampling. Interestingly, when considering geographical influences on therapy in Newfoundland, it is interesting that the qualitative and quantitative results were discordant. The qualitative study found that travel distance was problematic if related to life circumstances such as having school-aged children and not necessarily related just to resident location from the radiation treatment facilities. This is in contrast to the quantitative study, in which distance from radiation treatment facility was one of the only two significant factors to influence the likelihood of undergoing mastectomy. Certainly this would be an important area of further research.

9.5 Should Mastectomy and BCT Rates Be Used as a Quality Indicator?

9.5.1 Past and Present Use of Mastectomy and BCT Rates as a Quality Indicator

An important part of modern cancer care is ensuring quality of care, so that patients have access to services that are tailored to their needs and preferences, with practice patterns following the latest evidence-based medicine to ensure the best outcomes with appropriate use of resources. The Canadian Partnership Against Cancer (135) defines quality of care as ‘an all-encompassing’ dimension of performance that can be interpreted in many ways. In general, quality of care can be defined as ‘the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge’. (p.4)

The use of mastectomy or BCT rates as a quality indicator has been proposed and used in the past. In Canada, the 2012 CPAC report on ‘Breast Cancer Control in Canada: A system performance special focus report’ specifically uses mastectomy compared with BCT in the surgical treatment of breast cancer as the first set of breast cancer treatment indicators.(11) Although the report also discusses associated factors such as age, neighborhood income quintile, and travel time, the focus of that chapter is on the interprovincial mastectomy rates themselves.

In Europe, a non-profit group called the European Society of Breast Cancer Specialists (EUSOMA) was commissioned to create quality indicators guidelines for breast cancer care as part of the European Union’s goal of improving cancer care goals.(122,123) These guidelines are intended to provide breast cancer units across the continent with a defined set of quality indicators that can be used for certification and ongoing quality assessment. These guidelines are comprehensive in breast cancer care, including diagnosis,

treatment and follow-up; each of the quality indicators is labelled as either mandatory or recommended. Drawing attention to their recommendations for BCT rates, both the original position paper in 2010 and the 2017 update have a minimum standard BCT rate of 70% and a suggested target rate of 80%. Specifically, the indicator is stated as follows: 'Proportion of patients (BRCA1 and BRCA2 patients excluded) with invasive breast cancer not greater than 3cm (total size, including DCIS component) who underwent BCT as primary treatment'.(123) This indicator is mandatory and the level of evidence displayed is I, which is the highest level of evidence.

Explanation of the motivation behind this mandatory quality indicator, however, is poor: 'to conserve the organ with related effects ... The rate is related to a large number of factors including (expected) cosmetic outcome, patient preference and access to radiation therapy'.(123) If the rate and choice of therapy are related to patient preference, then a recommending a BCT rate of 80% seems contradictory unless the patient preferences themselves are evaluated. Furthermore, the justification of this indicator with level one evidence is also concerning. The guideline authors support this by citing the equivalence of treatment between BCT and mastectomy for ESBC, which is widely accepted. However, the equivalence of treatment itself does not relate or justify the use of a high BCT rate as a quality indicator. They go on to say 'preservation of the breast has an important impact on life quality' but fail to support this with any cited literature.(123)

The use of BCT rate as quality indicator has also been proposed in individual countries' quality assurance guidelines. In Belgium, Stordeur et al published an article in 2012, 'Developing and measuring a set of process and outcome indicators for breast cancer', that proposed a set of thirty-two quality of care indicators for their nation's breast cancer

care.(124) Once again, the use of the proportion of women with ESBC who undergo BCT, a goal of 70-80%, is used as a quality indicator. This is again supported by level A evidence, the highest level of evidence in their report. As with the EUSOMA guidelines, there are persistent concerns associated with this indicator and the supporting evidence. What is interesting in this report is the focus on indicators that are measurable within the current Belgium data system. – but even when data are available, scrutiny is required to evaluate the meaning and purpose of the data prior to use.

9.5.2 Is BCT a Superior Treatment to Mastectomy?

Many individual institutions that promote BCT as the ‘superior’ therapeutic course for patients.(125,136) One American author states that ‘breast conservation is considered by many to be the standard of care. With this in mind, a surgeon’s, practice’s or hospital’s breast conservation rate ... has become a marker of appropriate care’. (125) (p.37) This view of the treatment preferences for ESBC is a clear example of the biased belief that BCT is the better treatment among many clinicians – a view that has also been reported by other authors in the literature.(64) It is also often suggested that BCT is ‘underused’ or mastectomy ‘overused’.(137,138) The most radical view we have observed in the literature is by Johns et al., who conclude that ‘it no longer seems logical to offer all patients with early stage breast cancer, who are not gene carriers, the option of BCT or mastectomy. Such patients should be advised that BCT is their optimal treatment’.(136) (p.1,639)

The belief that BCT is the ‘preferable’ treatment over mastectomy stemmed from the landmark 1991 National Institute of Health Consensus Conference on the treatment of ESBC.(10) The specific recommendation states: ‘Breast conservation treatment is an appropriate method of primary therapy for the majority of women with stage I and II breast

cancer and is preferable because it provides survival rate equivalent to those of total mastectomy axillary dissection while preserving the breast'.(10) (p. 394) The focus of the report is affirming that BCT is an equivalent treatment to mastectomy in terms of survival and outlining oncological principles of BCT. Looking closer at the discussion around therapy choice, cosmetic result is emphasized as a primary goal along with local-regional oncological control. They go on to suggest the patient should make an informed decision and that 'a woman's body image and her beliefs and concerns may determine her preference for breast conservation treatment or mastectomy'.(10) (p. 392)

At the time of the conference, significantly less was known about influencing factors on women's choices between mastectomy compared with BCT. It is logical that physicians would assume that preservation of breast tissue and cosmetic outcome is a priority for female patients; such a belief appears to have led to identifying BCT as the 'preferable' treatment. Although cosmetic result and preservation of breast tissue are important factors that influence treatment choice, we now know that a number of other important personal preference factors influence decision-making.(121) Influences such as worry about cancer recurrence, desire to avoid radiation, and physician influences, to name a few, were likely not recognized as important influences or were underappreciated at the time of the conference. Furthermore, medical practices have continued to shift from a more paternalistic model in the past to one that is patient-centered and that encourages shared-decision-making.(43,139–141)

9.5.3 The Current Management of Early Stage Breast Cancer in Canada

In North American, major treatment guidelines support offering patients choice of mastectomy versus BCT. The National Comprehensive Cancer Network (NCCN), which is

the resource most frequently referred to by physicians for cancer treatment algorithms, displays both mastectomy or BCT as treatment options for patients; conveying no specific recommendation of or preference for one treatment over the other.(25) In Canada, Cancer Care Ontario is another frequently used resource for cancer treatment guidelines. These guidelines specifically recommend offering patients who have ESBC the choice of BCT or mastectomy, and stating that the treatment ‘should be dependent upon patient preference where appropriate’.(142)

9.5.4 A Shift in Philosophy Beyond the Mastectomy Rate

Previous sections of this chapter have highlighted what I believe to be the inappropriate use of mastectomy rates as a quality of care indicator, along with some of the bias in the medical field towards viewing BCT as a superior treatment for ESBC. However, I believe that BCT and mastectomy are both valid treatments for ESBC and should thus be offered to patients with full explanations of each therapy’s risks and benefits. As more understanding is gained of how complex and varied individual decision-making can be, the literature is also showing an increasing recognition and advocacy against the use of mastectomy or BCT rates as a quality indicator.(128,137,143)

Equipped with an improved understanding of the complexities behind patient therapy choice and the shift away from many health care systems’ previous bias towards BCT as the ‘preferred’ therapy, we recommend that the use of mastectomy or BCT rates should be discontinued. Looking at mastectomy rates alone is not in line with viewing both therapy choices as equal. In fact, continued focus and reporting on mastectomy rates will likely perpetuate pre-existing biases towards BCT as ‘preferable’ therapy among health care professionals. Even worse is the use of BCT rate as a quality indicator target. Both practices

may influence health care professionals, and subsequently the health care systems, to deliver care that is biased. A biased physician's overemphasis of BCT can be detrimental to patient-physician communication, ultimately leading to treatment that is not actually in line with patient preferences and wishes.

9.5.5 The Future of Evaluating Treatment Decision-Making in ESBC

Although we oppose the use of mastectomy rates as a quality indicator, we emphasize the importance of continued efforts to improve the quality of cancer care delivery, as well as the use of auditing practices to ensure that outcomes align with treatment goals.(135) If decision-making between mastectomy versus BCT in cases of ESBC is still to be used as a quality indicator, then a shift is needed to align quality indicators with modern treatment goals, the most important of which is to identify and minimize inequalities related to access of treatment for patients, to the best of our ability. Close after is finding out whether patients are being offered treatment choices and if the treatment they receive is in line with their wishes.

From the standpoint of inequality, two potentially concerning elements reported in some of the literature are the association of low SES or income and geographic distance to radiation centre.(121) Although income is generally less a concern in Canada than in the United States, as the direct costs of healthcare insurance are universal, indirect costs and life circumstances for individuals of lower SES may affect their ability to comply with the BCT treatment time length. From a quality assurance viewpoint, it may be difficult to measure at an individual level how income and SES directly influence therapy choice. However, checkpoints can be put place at a breast unit level. For example, although the standard radiation timeframe is 5 weeks, the local radiation oncologist can offer a shorter

course therapy to certain individuals that takes 3.5 weeks. A quality indicator can be created to measure whether all of the breast unit surgeons and nurse navigators are aware of this option and whether this option is made evident in informational pamphlets. From a geographical and standpoint, Canada has a large landmass-to-population ratio, and the national reports have shown increased mastectomy rates with increasing distance to radiation treatment centre.(1) Because increasing the number of rural radiation treatment centres is not a feasible solution, we need to develop other solutions are needed to ensure that patients have access to all treatment options. For example, the SCA offers subsidized lodging to cancer patients, and delivery of this information can be used as a quality indicator. Additionally, these patients should also be informed of the potential shorter course radiation treatments.

If we believe that treatment for ESBC is truly 'preference-sensitive care' that should thus depend on patient preference factors, then ensuring proper deliver of treatment options to the patient is critical. This can be measured at the individual level through occasional audits asking patients what therapy choices they were offered. At a breast unit level, availability of informational pamphlets or handouts bearing a detailed explanation of treatment choices and their associated risks and benefits could also be a quality indicator.

Measurement of the interaction between the physician-patient dyad is more complicated. The most commonly accepted models of decision-making are presented in Charles et al and include the paternalistic, shared, and informed models.(40,41) Full explanations of these are explained in Chapter 2.5. Multiple studies have demonstrated that involvement in the decision-making process to be associated with better mental health and quality of life.(144–148) However, level of involvement in the decision-making process

appears to vary among individuals. Role congruence, which is the preferred level of involvement compared with the actual level of involvement in the decision-making process, has also been associated with treatment satisfaction and quality of life, and in some studies, has been more important than shared decision-making itself.(148–150)

Ireland provides an excellent example of incorporating patient choice into their breast cancer quality indicators. Ireland's National Quality Assurance Standards for breast cancer care specifically require that the consulting surgeon discuss all treatment options with the patient with a target goal of 90%.(151) As a second indicator in the decision-making process, they ask that the patient be actively involved in the decisions concerning their treatment, with a target goal of 95%. These are excellent examples of quality indicators that promote an informed patient-oriented treatment decision that can also be measurable. We suggest that other breast units consider incorporating these measures when evaluating patient care outcomes.

9.6. Conclusion

The choice of mastectomy versus BCT in ESBC is a complicated decision-making process that is influenced by a wide array of factors. Organizing these factors using a framework is important in understanding their relationships and future research endeavors. In Saskatchewan, the choice of therapy was primarily influenced by disease stage and individual belief factors, suggesting that the mastectomy rate in Saskatchewan does not reflect a quality of care issue. We advise administrators against using mastectomy or BCT rates as an indicator of quality of care in the future. Instead, attention should be shifted towards care that is patient-centered.

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APPENDICES

Appendix A – Methods used to define patient treatment episode in CIHI / CPAC report

(12)

Index surgical interventions and subsequent one-year treatment episodes were constructed using the following steps:

1. Select all inpatient and day surgery records from 2006-2007 to 2010-2011 meeting the following inclusion/exclusion criteria for surgical treatment of breast cancer:

Inclusion Criteria

- Gender = female
- Age \geq 18 years
- Discharged from acute care or day surgery facility
- Breast cancer surgical intervention coded anywhere in the abstract and location attribute in right, left, bilateral
- Breast cancer or ductal carcinoma in situ (DCIS) diagnosis code coded as most responsible diagnosis (MRDx)

Exclusion Criteria

- Potential duplicate records removed from analysis
- Invalid Health Card Number
- Health Province Code = CA
- Invalid postal code
- Procedures coded as abandoned
- Newborns, stillbirths and cadaveric donors
- Invalid episode date

2. Link records to identify all inpatient and day surgery records associated with individual patients.
 - a. Construct unique patient ID based on encrypted health card number and person's birth
3. Identify patient's index surgery. Sort records by procedure, location of care (inpatient versus day surgery), admission date and discharge date.
 - a. When multiple procedures are coded in the same record, prioritize mastectomy over BCS.
 - b. When multiple procedures of the same type occurred on the same day in different locations of care, prioritize inpatient records over day surgery records
4. Remove patients who do not meet the criteria for first treatment.
 - a. Exclude patients with a discharge in 2006-2007.
 - b. Exclude patients whose first discharge indicates a past history of breast cancer.
5. Select all index records from the treatment episodes.
 - a. The index record contains each patient's first surgical intervention for breast cancer.
6. Extract all records linked to index patient that include admission dates on or after the date of the index surgery.
7. Exclude records with discharge dates greater than 365 days after the discharge date for the index surgery.

Appendix B – Literature search strategy for Medline

1. Choice Behavior/
2. Decision Making/
3. shared decision*.ab,ti.
4. sharing decision*.ab,ti.
5. informed decision*.ab,ti.
6. informed choice*.ab,ti.
7. decision aid*.ab,ti.
8. ((share* or sharing* or inform*) and (decision* or deciding or choice*)).ti.
9. decision support techniques/
10. Decision Support Systems, Clinical/
11. decision mak*.ab,ti.
12. decision support*.ab,ti.
13. choice behaviour*.ab,ti.
14. choice behavior*.ab,ti.
15. ((decision* or choice*) and (making* or support* or behaviour* or behavior*)).ti.
16. decid*.ab,ti.
17. choos*.ab,ti.
18. consumer participation/ or patient participation/
19. patient participation*.ab,ti.
20. consumer participation*.ab,ti.
21. patient involvement*.ab,ti.
22. consumer involvement*.ab,ti.
23. ((patient* or consumer*) and (involvement* or involving* or participat*)).ti.
24. ((treatment* or surg*) adj3 choice*).ab,ti.
25. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
26. mastectomy/ or mastectomy, simple/ or mastectomy, subcutaneous/
27. mastectom*.ab,ti.
28. 26 or 27
29. Mastectomy, Segmental/
30. breast conserv*.ab,ti.
31. lumpect*.ab,ti.
32. radiotherapy/ or radiotherapy, adjuvant/
33. (radiotherap* or radiation*).ti.
34. ((segmental or resection or "local excision") adj mastectom*).ab,ti.
35. 29 or 30 or 31 or 32 or 33
36. breast neoplasms/ or carcinoma, ductal, breast/
37. Breast cancer*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
38. Breast Neoplasm*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

39. Ductal Carcinoma*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
40. Lobular Carcinoma*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
41. (breast adj25 neoplasm\$).ti,ab,sh.
42. (breast adj25 cancer\$).ti,ab,sh.
43. (breast adj25 tumour\$).ti,ab,sh.
44. (breast adj25 tumor\$).ti,ab,sh.
45. (breast adj25 carcinoma\$).ti,ab,sh.
46. (breast adj25 adenocarcinoma\$).ti,ab,sh.
47. (breast adj25 ductal).ti,ab,sh.
48. (breast adj25 infiltrating).ti,ab,sh.
49. (breast adj25 intraductal).ti,ab,sh.
50. (breast adj25 lobular).ti,ab,sh.
51. (breast adj25 medullary).ti,ab,sh.
52. "neoplasms, ductal, lobular, and medullary"/ or carcinoma, ductal/ or carcinoma, ductal, breast/ or carcinoma, lobular/ or carcinoma, medullary/
53. (breast adj25 tubular).ti,ab,sh.
54. (breast adj25 mucinous).ti,ab,sh.
55. (breast adj25 papillary).ti,ab,sh.
56. (breast adj25 tubulolobular).ti,ab,sh.
57. (breast adj25 metaplastic).ti,ab,sh.
58. (breast adj25 "adenoid cystic").ti,ab,sh.
59. 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58
60. 25 and 28 and 35 and 59
61. limit 60 to (english language and yr="2000 -Current")

Appendix C – Systematic review screening questions and forms

Title Screening

1. Does this article relate to early stage breast cancer?
 - a. Yes
 - b. No
 - c. Uncertain
2. Does this article relate to decision making about mastectomy vs BCT?
 - a. Yes
 - b. No
 - c. Uncertain

Abstract Screening

1. Does this article relate to early stage breast cancer?
 - a. Yes
 - b. No
 - c. Uncertain
2. Does this article relate to decision making about mastectomy vs BCT?
 - a. Yes
 - b. No
 - c. Uncertain
3. Does this article represent a primary study or a review? (i.e., No letters to the editor, book reviews). Published study designs or trial protocols to be included
 - a. Yes
 - b. No
 - c. Uncertain
4. Is the text in English?
 - a. Yes
 - b. No
 - c. Uncertain
5. Is the publication from 2000 or onwards?
 - a. Yes
 - b. No
 - c. Uncertain
6. Is the geography and culture of a comparable health care system? (i.e., North America, Europe, Australia, New Zealand)
 - a. Yes
 - b. No
 - c. Uncertain
7. Does the study look at traditional Stage I/II breast cancer? i.e., Not any of the following: DCIS, Stage 3/4 Breast Cancer, BRCA, Male Breast Cancer
 - a. Yes
 - b. No
 - c. Uncertain

If “No”, which of the following does the study include:

- a. Benign Breast Disease
 - b. DCIS
 - c. Stage 3/4 Breast Cancer
 - d. BRCA
 - e. Male Breast Cancer
 - f. Inflammatory Breast Cancer
8. Does BCT include radiation as part of its standard treatment
 - a. Yes
 - b. No
 - c. Uncertain
 9. Is this considering primary therapy only? ((i.e., Not re-resection or secondary radiation?)
 - a. Yes
 - b. No
 - c. Uncertain
 10. Is the focus of the study on factors that influence 'decision making' for the patient? (ie. Not measuring a decision aid, not measuring an education process, not measuring if a certain decision was reached)
 - a. Yes
 - b. No
 - c. Uncertain

Full-Text Screening

1. Does this article represent a primary study or a review? (i.e., No letters to the editor, book reviews). Published study designs or trial protocols to be included
 - a. Yes
 - b. No
 - c. Uncertain
2. Is this article a full length journal article? (i.e., Not an abstract)
 - a. Yes
 - b. No
3. Is the text in English?
 - a. Yes
 - b. No
 - c. Uncertain
4. Is the publication from 2000 or onwards?
 - a. Yes
 - b. No
 - c. Uncertain
5. Is the geography and culture of a comparable health care system? (i.e., North America, Europe, Australia, New Zealand)
 - a. Yes
 - b. No
 - c. Uncertain
6. Does the study look at traditional Stage I/II breast cancer? i.e., Not any of the following: DCIS, Stage 3/4 Breast Cancer, BRCA, Male Breast Cancer

- a. Yes
 - b. No
 - c. Uncertain
- If "No" , which of the following does the study include:
- i. Benign Breast Disease
 - ii. DCIS
 - iii. Stage 3/4 Breast Cancer
 - iv. BRCA
 - v. Male Breast Cancer
 - vi. Inflammatory Breast Cancer
7. Is this considering primary therapy only? (i.e., Not re-resection or secondary radiation?)
- a. Yes
 - b. No
 - c. Uncertain
8. Is the focus of the study on factors that influence 'decision making' for the patient? (ie. Not measuring a decision aid, not measuring an education process, not measuring if a certain decision was reached)
- a. Yes
 - b. No
 - c. Uncertain
9. Does BCT include radiation as part of its standard treatment
- a. Yes
 - b. No
 - c. Uncertain
10. What is the study design of this article?
- a. Quantitative
 - i. Literature Review
 - ii. RCT
 - iii. Cohort
 - iv. Case-Control
 - v. Survey
 - vi. Case-report / Series
 - b. Qualitative
 - c. Mixed

Appendix D – Thematic Index

1. Demographic Factor

- 1.1 Employment
- 1.2 Age
- 1.3 Urban/Rural
- 1.4 Ethnicity
- 1.5 Distance from treatment center
- 1.6 Comorbid disease
- 1.7 Previous Cancer Hx
- 1.8 Family Hx of Breast Ca

2. Surgeon Influences

- 2.1 Recommendations
- 2.2 Reputations
- 2.3 Trust/Faith in Surgeon

3. Family / Friend Influences

- 3.1 Pos Mastectomy Worked
- 3.2 Pos BCT Worked
- 3.3 Family recommended treatment
- 3.4 Failed Therapy BCT
- 3.5 Failed Therapy Mastectomy

4. Feminine Identity

- 4.1 Breast Reconstruction
- 4.2 Body Image
- 4.3 Sexuality / Desirable / Attractiveness
- 4.4 Being Whole / Retained breast
- 4.5 Self-esteem

5. Minimizing Cancer Recurrence

- 5.1 Worry about coming back
- 5.2 Increase chance of cure
- 5.3 Desiring double mastectomy
- 5.4 Not scared to die

6. Peace of Mind / Get rid of it

7. Radiation Therapy

- 7.1 Avoid Radiation Therapy
- 7.2 Travel Distance
- 7.3 Travel Distance not an issue
- 7.4 Length of treatment
- 7.5 S/E of radiation
- 7.6 Recovery time

7.7 Radiation not an issue

8. Resources / Other Influences

- 8.1 Surgeons / Medico-professionals
- 8.2 Family / Friends
- 8.3 TV / Book / Website

9. Personal Life Circumstances

- 9.1 Family Situation
- 9.2 Vacation
- 9.3 Work (go back sooner)
- 9.4 Recreational activities
- 9.5 Be Normal

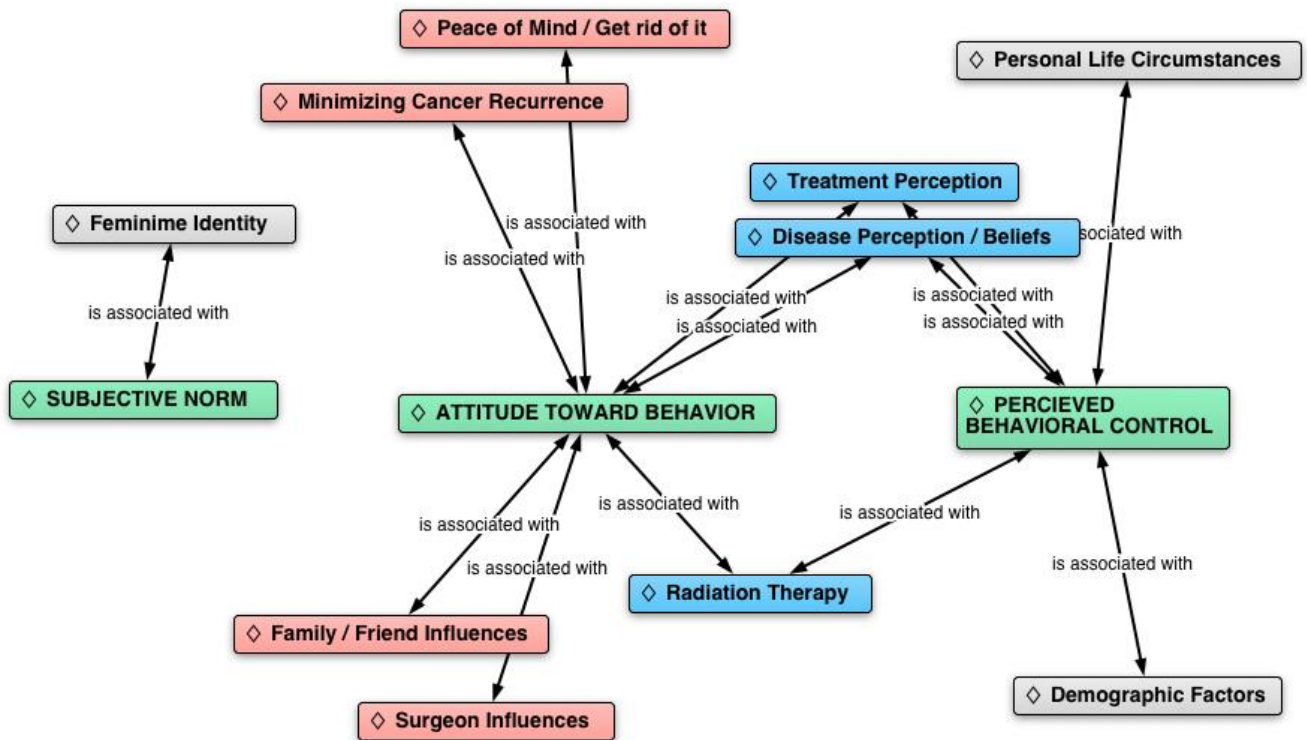
10. Disease Perception / Beliefs

- 10.1 Tumor Size / Location
- 10.2 Breast Size
- 10.3 BCT vs Mast treatment superiority

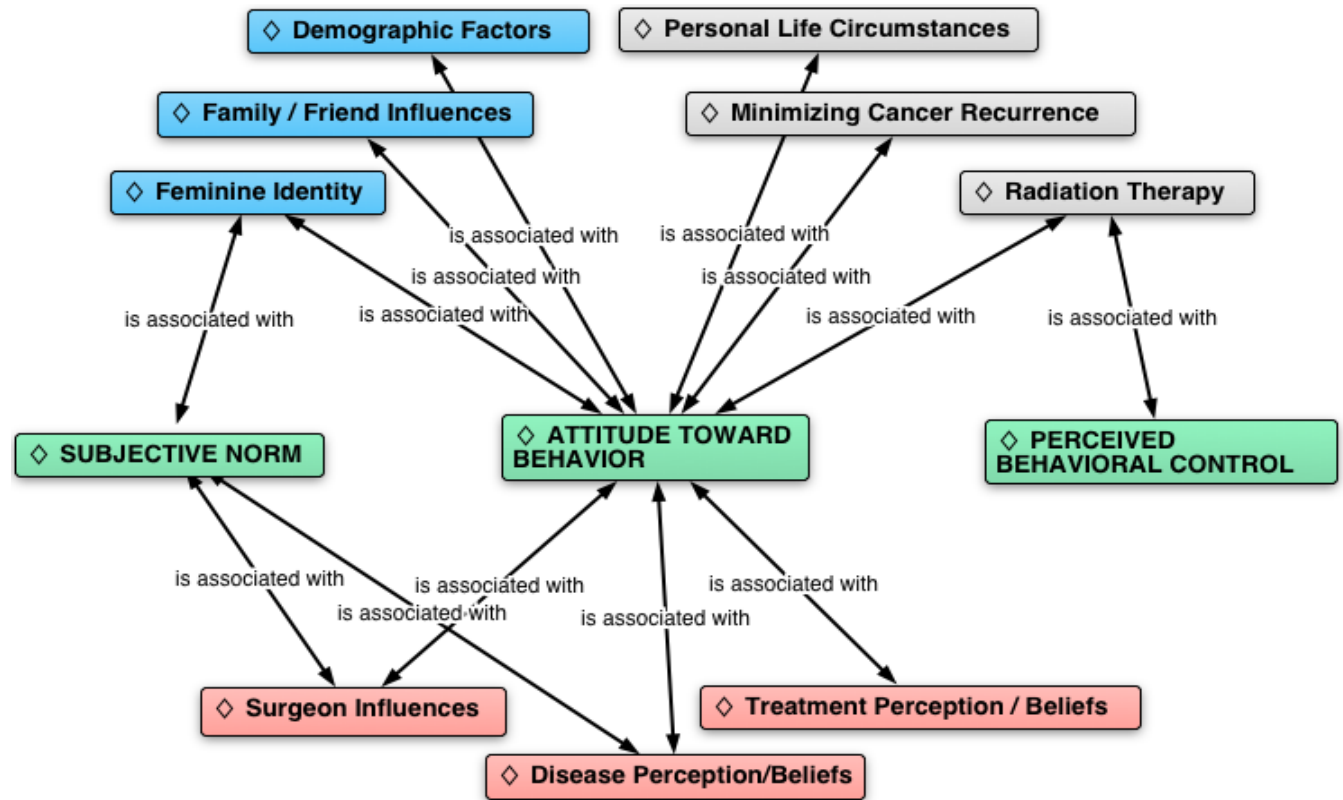
11. Treatment Perception / Beliefs

- 11.1 Avoid f/u imaging
- 11.2 Avoid additional surgery
- 11.3 Potential for more surgery okay
- 11.4 Perceived size of Surgery Radical
- 11.5 Perceived recovery time
- 11.6 Perceived longer life
- 11.7 Other treatment S/E
- 11.8 Decreasing Length of treatment |

Appendix E – Candidate concept map for mastectomy participants



Appendix F – Candidate concept map for BCT participants



Appendix G – Qualitative study interview guide

1. Can you tell me about your breast cancer diagnosis? (Follow-up questions to elicit details regarding events leading up to and during diagnosis).
2. What were the treatment options suggested to you and what surgical intervention did you choose?
3. What factors contributed to your decision to have _____?
 - a. Did you have past experiences with breast cancer or cancer of any type and did this influence your treatment choice?
 - b. Did a friend or family's experience with breast cancer factor into your choice of therapy?
 - c. What therapy did your surgeon suggest and how did this contribute to your decision?
 - d. How did employment effect your decision?
 - e. How did your living distance to the treatment center effect your decision?
 - f. Did you think one treatment was superior to the alternative/s? Why?
 - g. Did breast reconstruction factor into your decision?
 - h. What role did radiation therapy have on your decision (5 week process of radiation, potential side-effects of radiation)
 - i. Do you think your health or other medical conditions at the time influence your decision?
4. Were there specific personal values that contributed to your decision regarding your therapy choice?
 - a. Retaining your breast/s
 - b. Minimized chance of cancer reoccurrence
 - c. Avoiding radiation
 - d. Wanting to do everything possible to get well
 - e. Minimize the length of treatment
 - f. To do what the doctor thinks is best
 - g. Remove the breast/s for peace of mind.
5. Do you feel that your therapy choice was in line with your personal values? If no, why?
6. (if not already mentioned) During your decision-making regarding your surgery what resources did you seek? (other physicians' opinions, literature, internet, family, friends, etc.)
7. (if not already mentioned) Tell me a little about your personal/home/family life and how these contributed to your decision making? (Follow-up questions to elicit details regarding children, ages, working outside the home, employment and

sick/disability leave, spouse, stability of household income, religious affiliations, distance from the hospital etc.)

8. (if not already mentioned) Do you know someone close to you who had/has an intimate experience with breast cancer and how did that play into your decision making ?
9. (if not already mentioned) Do you feel that you were adequately informed and had sufficient information to make the decision of which surgery to choose and if not what else would you have liked to know?
10. During the decision making process did you have any uncertainties? If yes, please explain.
11. Did your decision regarding therapy choice change after you spoke with the surgeon? Please explain.
12. How did you make your decision regarding treatment?
 - i. Made the decision yourself after listening to the options
 - ii. Sharing the decision
 - iii. Decision made by someone else

Thank you for your participation.

Appendix H – Full Survey: “An Examination of Why Saskatchewan Women Choose Mastectomy Versus Breast Conservation Therapy in Early Stage Breast Cancer”

“An Examination of Why Saskatchewan Women Choose Mastectomy Versus Breast Conservation Therapy in Early Stage Breast Cancer”

Participation in this research is voluntary, and you can stop your participation at any time. After completion of the survey, certain pre-defined data items about your pathology and from your chart will be disclosed in a de-identified manner by the Saskatchewan Cancer Agency and linked to your survey results. Please know you cannot be personally identified based on the data we collect. This research project has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

For more information on the study itself please contact by email or phone Dr. Jeffrey Gu (jeg998@mail.usask.ca, (306) 262-3537) or Dr. Gary Groot (garygroot@gmail.com, (306) 653-3366). For study results, please contact the researchers in January 2018. If you do not want to participate in this project or if you want to be removed from our mailing list, please contact Serena Kozie at the Saskatchewan Cancer Agency at (639) 625-2045 or by email at serena.kozie@saskcancer.ca

There are no known risks to participating in this survey; however, as with any online related activity the risk of breach of confidentiality is possible. If you decide not to participate or withdraw from the study, your treatment and medical care will not be affected.

This survey is hosted by Voxco, a Canadian-owned and managed company whose data is securely stored in Canada. Consider printing this page for your records.

In order to complete this survey, you may be required to answer certain questions; however, you are never obligated to respond and you may withdraw from the survey at any time by closing your internet browser.

By completing and submitting the questionnaire, YOUR FREE AND INFORMED CONSENT IS IMPLIED and indicates that you understand the above conditions of participation in this study.

☐ I consent

[Linking Variable]

Please type the identification code you were provided in your recruitment letter.

Q.1 [Screener]

What was your initial treatment choice?

1. Mastectomy
2. Breast conservation therapy (lumpectomy and radiation)

Q2. [High Level Questions about personal values and beliefs]

[All items under question 2 will be randomized for each participant]

[All items under question 2 will be presented 1 at a time]

[All items under question 2 will be presented a 5-point likert scale from strongly disagree to strongly agree]

[All items under questions 2 will have the following pre-ample]

“Taking your time to think through each question, please indicate the extent to which you agree with the following statements. Please think back to when you made your initial treatment choice. Keep in mind that there are no right or wrong answers.”

- My worry about cancer recurrence influenced my choice of therapy
- My age influenced my choice of therapy
- Other individual medical or health concerns influenced my choice of therapy
- My family history of breast cancer influenced my choice of therapy
- My previous experience with breast cancer or breast disease influenced my choice of therapy
- My breast size influenced my choice of therapy
- The tumor size influenced my choice of therapy
- The travel distance to the treatment center (for surgery or radiation) influenced my choice of therapy
- My surgeon’s opinion influenced my choice of therapy
- My feminine identity influenced my choice of therapy.
- My sexuality influenced my choice of therapy
- Wanting to keep my own breast tissue influenced my choice of therapy
- Incorporating reconstruction influenced my choice of therapy
- The total time required to treat my breast cancer influenced my choice of therapy

Q2A1. These questions will be displayed for those selecting mastectomy only.

(Items still included in the randomization)

- Wanting to avoid the potential for requiring further surgery influenced my choice of mastectomy
- The length of radiation treatments required for breast conservation therapy influenced my choice of mastectomy
- Lodging or housing required in order to undergo radiation treatments influenced my choice of mastectomy
- Wanting to avoid radiation treatments influenced my choice of mastectomy

- Wanting to remove my other breast without cancer (prophylactic mastectomy) influenced my choice of mastectomy

Q2A2. (Items not included in the randomization)

- Did your doctors discuss that breast conservation therapy was a possible treatment option for you?
 - Yes
 - No
 - Do not remember
- In your decision to undergo mastectomy, please indicate your involvement in the decision-making process:
 - Completely your choice, no physician input
 - Mostly your choice, minimal physician input
 - A shared decision-between you and your physician
 - Mostly your physician's choice
 - Completely your physician's choice, no individual input

Q2B1. These questions will be displayed for those selecting breast conservation therapy only.

(Items still included in the randomization)

- The recovery time for undergoing mastectomy influenced my choice of breast conservation therapy
- Feeling that mastectomy was too radical or extreme of a procedure influenced my choice of breast conservation therapy

Q2B2. (Items not included in the randomization)

- Did your doctors discuss that mastectomy was a possible treatment option for you?
 - Yes
 - No
 - Do not remember
- In your decision to undergo breast conservation therapy, please indicate your involvement in the decision-making process:
 - Completely your choice, no physician input
 - Mostly your choice, minimal physician input
 - A shared decision-between you and your physician
 - Mostly your physician's choice
 - Completely your physician's choice, no individual input
- Did you require further surgical procedures beyond your initial lumpectomy?
 - No
 - Yes
 - Re-excision for a positive margin with lumpectomy
 - Re-excision for a positive margin with mastectomy
 - Re-excision for local recurrence with lumpectomy
 - Re-excision for local recurrence with mastectomy
 - Other, please specify:

Q3. [Follow-up / Secondary questions for personal values and beliefs]

[All items under question 3 will use display logic for relevant questions]

[All items under question 3 will use the following pre-ample:]

“You indicated BLANK was important in choosing breast conservation therapy/mastectomy.”

- i. If **worry about cancer recurrence** is selected, display:

Do any of the following impact your worry about cancer recurrence? Please select all that apply. [USE SELECT ALL THAT APPLY OR RATE THEM INDIVIDUALLY AGAIN]

- a. Someone close to you had a negative outcome with breast conservation therapy
- b. Someone close to you had a positive outcome with mastectomy
- c. You would like to avoid follow-up imaging
- d. You have a family history of breast cancer
- e. Your age
- f. Other, please specify:

- ii. *If **breast size** is selected, display:* Since you selected breast size was an impacting factor on your choice of therapy. Which of the following options related to this decision.

- a. *Large breast size*
- b. *Small breast size*

- iii. *If **tumor size** is selected, display:* Since you selected tumor size was an impacting factor on your choice of therapy. Which of the following options related to this decision.

- a. Large tumor size
- b. Small tumor size

- iv. *If **travel distance** selected, display:* Since you selected travel distance was an impacting factor on your choice of therapy. Please explain how travel distance was an impacting factor in your choice of therapy?

- a. *Open-ended answer space*

- v. *If **surgeon influence** selected, display:* Since you indicated surgeon influence was an impacting factor on your choice of therapy, could you please explain why the surgeon suggested this option for you?

- a. *Open-ended answer space*

- vi. *If **feminine identity/feeling whole as a woman** selected, display:* Please explain how feminine identity impacted your choice of therapy.

- a. *Open-ended answer space*

- vii. *If **sexuality** selected, display:* Please explain how feminine identify impacted your choice of therapy.
 - a. *Open-ended answer space*
- viii. *If **mastectomy is too radical or extreme** selected, display:* Since you indicated feeling that mastectomy is radical or extreme, were any of the following options related to this decision? Please select all that apply:
 - a. Your confidence in breast conservation therapy
 - b. Survival is equivalent between breast conservation therapy and mastectomy
 - c. Small tumor size
 - d. Recovery time would be shorter with breast conservation therapy compared with mastectomy
 - e. Other, please specify:
- ix. *If **length of radiation treatments** selected, display:* You indicated length of radiation treatments required for breast conservation therapy influenced your choice of mastectomy. What options were offered to you in regards to length of radiation treatments?
 - a. 25 fractions taking 5 weeks
 - b. 16 fractions taking 3.5 weeks
 - c. The choice of 5 or 3.5 weeks
 - d. Do not remember
- x. *If **lodging or housing required** selected, display:* You indicated lodging or housing required for radiation treatments influenced your choice of mastectomy. Were you informed that there was lodging available to you across from the cancer centre?
 - a. Yes
 - b. No
- xi. *If **total time of treatment** selected [for **mastectomy** patients] display:* You indicated total time of treatment was important in choosing mastectomy. Please explain why.
 - a. Open ended answer
- xii. *If **total time of treatment** selected [for **breast conservation therapy** patients] display:* You indicated total time of treatment was important in choosing mastectomy. Which of the following impact this choice? Please select all that apply
 - a. Time away from work
 - b. Time away from family
 - c. Time away from leisure activities
 - d. Other, please specify:

Q4. [Ranking for most influential factors of therapy]

[Please select up to five factors that most influenced your choice of therapy. Please drag and drop your choices into the selection box.]

[Please take your time to think through each option, keeping in mind that there are no right or wrong answers.]

[Options will be randomized]

- 1.
- 2.
- 3.
- 4.
- 5.

Q.5. [Decisional Conflict Scale]

[All items under question 5 will be presented in order]

[All items under question 5 will be presented in 1 table]

[All items under question 5 will be presented a 5-item likert scale from strongly disagree to strongly agree]

[All items under questions 5 will have the following pre-amble]

Please think back to the time you made your choice of therapy and indicate the level to which you agree with the following statement.

Informed Subscale:

I knew which options were available to me.

I knew the benefits of each option.

I knew the risks and side effects of each option.

Values Clarity Subscale:

I was clear which benefits mattered most to me.

I was clear about which risks and side effects mattered most.

I was clear about which is more important to me (the benefits or the risk and side effects)

Support Subscale:

I had enough support from others to make a choice

I was choosing without pressure from others

I had enough advice to make a choice

Uncertainty Subscale:

It was clear from me what was the best choice was

I felt sure about what to choose

The decision was easy for me to make

Effective Decision Subscale

I felt I made an informed choice

My decision showed what was important to me

I expected to stick with my decision

I was satisfied with my decision

Q.5b. [Decisional Conflict Scale Addendums]

[All items under question 5 will be presented in order]

[All items under questions 5 will have the following pre-ambles]

Please think back to the time you made your choice of therapy and indicate the level to which you agree, disagree, or unsure with the following statements.

- Overall survival is the same between mastectomy and breast conservation therapy
- Overall survival is higher with mastectomy
- Overall survival is higher with breast conservation therapy
- Local recurrence rate is the same between mastectomy and breast conservation therapy
- Local recurrence rate is higher with mastectomy
- Local recurrence rate is higher with breast conservation therapy

Please indicate where most of your support came from during your treatment decision-making process. Please select all that apply.

- Family members
- Friends
- Physician
- Nursing support
- Social media
- Other, please specify:

Finally, we would like to ask some questions about yourself.

Q6. Demographic Factors

1. Please provide your age at the time of surgery – *[Numerical]*
2. Please provide the first 3 characters of your postal code only. Your postal code will only be used to report travel-related difference by region/geography and will not be used to identify you in any way. Please use the format 'S7N'
3. Which best describes the area where you live?
 - a. Urban, please specify the city you live in:
 - b. Rural
4. Approximately how many kilometers (km) is your home away from the surgical centre?
5. Approximately how many kilometers (km) is your home away from the radiation centre?
6. Which city did you have your surgery in?
 - a. Saskatoon
 - b. Regina
 - c. Moose Jaw
 - d. Prince Albert
 - e. Lloydminster
 - f. North Battleford
 - g. Swift Current
 - h. Yorkton

7. Will you be staying at home or your primary residence during radiation treatments?
 - a. Yes
 - b. No, please specify where you will be staying:
 - c. Don't know/undecided
 - d. Not applicable
8. Weight + Height [*for BMI*]
 - a. [*Weight → Space for lbs or kg*]
 - b. [*Height → space for cm and ft+inches*]
9. What was your pre-operative breast cup size?
 - a. A
 - b. B
 - c. C
 - d. D
 - e. E
 - f. F
 - g. G
 - h. H
10. Did you have pre-operative breast MRI?
 - a. Yes
 - b. No
11. Were you offered reconstruction? (JUST MASTECTOMY)
 - a. Yes
 - i. Were you offered immediate reconstruction
 - ii. Were you offered delayed reconstruction
 - iii. Were you offered both?
 - b. No
12. Please list all medical conditions you have:
13. What was your total annual household income in 2015?
 - a. Less than \$20,000
 - b. \$20,000 - \$39,999
 - c. \$40,000 - \$59,999
 - d. \$60,000 - \$79,999
 - e. \$80,000 - \$99,999
 - f. \$100,000 - \$120,000
 - g. Greater than \$120,000
 - h. Prefer not to disclose
14. Are you currently employed?
 - a. Yes
 - b. No
15. Occupation
[display logic → only display if they are employed]
 - a. [*Open ended*]
16. What is the highest level of formal education you have received?
 - a. Less than high school
 - b. Completed high school
 - c. Some technical or community college

- d. Completed technical or community college
 - e. Some university
 - f. Bachelor's degree
 - g. Master's degree
 - h. Professional degree or doctorate
17. Were you in a relationship around the time of decision-making?
- a. Yes, I was in a relationship
 - b. No, I was not in a relationship
18. Do you have children?
- a. Yes
 - i. Please indicate how many children you have in the space provided:
 - b. No
19. Please indicate your smoking status
- a. I have never smoked cigarettes
 - b. I used to smoke cigarettes, but have quit
 - c. I currently smoke cigarettes
20. What ethnicity do you identify with?
- a. Caucasian
 - b. First Nation, Métis or Inuit?
 - c. Asian
 - d. African American
 - e. Hispanic
 - f. West Indian/Caribbean
 - g. Other
21. At the time of your diagnoses, are you pre or post menopausal? Menopause is defined as one full year with no menses)
- a. Pre-menopause
 - b. Post-menopause
22. If post menopausal, did you go through menopause because of surgical removal of your uterus or ovaries (hysterectomy or oophorectomy)
- a. Yes
 - b. No
23. Have you ever been tested positive for BRCA (a genetic marker indicating high risk breast cancer)?
- a. No
 - b. Yes
24. Have any of your family members ever been tested positive for BRCA?
- a. No
 - b. Yes
 - c. Unsure

Thank you so much for taking the time to complete this survey.

Data items not in the questionnaire. Information from the SCA:

- C-code (C-code = breast, and location – quadrant)
- C-code English description
- Morphology (Gross Histology)
- Morphology English description (ie. Ductal carcinoma)
- Behavior (All would be 3 = malignant (not in situ))
- Grade (Value of 1-4, or 9=unknown)
 - o 1 = Well differentiated
 - o 2 = Moderately differentiated
 - o 3 = Poorly differentiated
 - o 4 = Undifferentiated / anaplastic
 - o 9 = Unknown
- Laterality
- Multiplicity Counter (Number of tumors, ie. 1 or 2, 3.)
 - o Most patients with multiple tumors have the 'North American Multiple Primary and Histology Rule' – from SEER
 - o See below from more details →
- Tumor Size
- Regional Nodes Positive
- Regional Nodes Examined
- SSF 1 – ER Assay (010 = Positive or Negative or Not Done or Unknown [treated in different province])
- SSF 2 – PR Assay
- SSF 14- HER2: Result of Other or Unknown Test
- SSF 16 – Combination ER, PR & HER2
- Overall Stage, T, N and M stage values (JCC 7th Edition)
- Surgery Date
- Radiation therapy
- Chemo therapy
- Hormone therapy

Appendix I – Clinicopathological Data legend from the Saskatchewan Cancer Agency

1. **C-code** – the topographical code, which describes the anatomical code, which describes the anatomical site of origin (or organ system) of the tumour
 - a. C50.0 – Nipple
 - b. C50.1 – Central portion of breast
 - c. C50.2 – Upper-inner quadrant of breast
 - d. C50.3 – Lower-inner quadrant of breast
 - e. C50.4 – Upper-outer quadrant of breast
 - f. C50.5 – Lower-outer quadrant of breast
 - g. C50.6 – Axillary tail of breast
 - h. C50.8 – Overlapping lesion of breast
 - i. C50.2 – Breast, NOS
2. **C-code English description**
3. **Morphology** – the morphological code, which describes the cell type (or histology) of the tumour, together with the behavior
4. **Morphology English description**
5. **Behavior**
 - a. 0 (benign)
 - b. 1 (uncertain behavior)
 - c. 2 (carcinoma in situ)
 - d. 3 (malignant) {Results for your research project will all be /3 – malignant as per data selection}
6. **Grade**
 - a. Grade 1 – Well differentiated, differentiated NOS, low grade
 - b. Grade 2 – Moderately differentiated, moderately well differentiated, intermediate differentiation, intermediate grade
 - c. Grade 3 – Poorly differentiated, high grade
 - d. Grade 4 – Undifferentiated, anaplastic
 - e. Grade 9 – grade or differentiation not determined, not stated or not applicable
7. **Laterality** – right, left, paired no info (means breast is a paired site (right or left) but we didn't know which side the breast cancer/primary occurred on or we didn't know which side the breast cancer/primary occurred on or we didn't have enough information to capture laterality)
8. **Multiplicity Counter** – used to count the number of tumors (multiplicity) reported as a single primary
9. **Tumor Size**
 - a. 000 – No mass/tumor found
 - b. 001-988 – 001 – 0988 millimeters (mm) (Code exact size in mm)
 - c. 989 – 989mm or larger
 - d. 990 – Microinvasion, microscopic focus or foci only and no size given, described as “less than 1 mm”, Stated as T1mi with no other information on tumor size
 - e. 991 – Described as “less than 1 centimeter (cm)”, States as T1b with no other information on tumor size

- f. 992 – Described as “less than 2 cm,” or “greater than 1 cm,” or “between 1 cm and 2 cm”, Stated as T1 [NOS] or T1c [NOS] with no other information on tumor size
- g. 993 – Described as “less than 3 cm,” or “greater than 2 cm,” or “between 2 cm and 3 cm”
- h. 994 – Described as “less than 4 cm,” or “greater than 3 cm,” or “between 3 cm and 4 cm”
- i. 995 – Described as “less than 5 cm,” or “greater than 4 cm,” or “between 4 cm and 5 cm”, Stated as T2 with no other information on tumor size
- j. 996 – Mammographic/xerographic diagnosis only, no size given; clinically not palpable
- k. 997 – Pagets disease of nipple with no demonstrable tumor
- l. 998 – Diffuse
- m. 999 – Unknown; size not stated, Size of tumor cannot be assessed, not documented in patient record

10. Regional Nodes Positive

- a. 00 – All nodes examined negative
- b. 01-89 – 1-89 nodes positive (code exact number of nodes positive)
- c. 90 – 90 or more nodes positive
- d. 95 – Positive aspiration or core biopsy of lymph node(s)
- e. 97 – Positive nodes – number unspecified
- f. 98 – No nodes examined
- g. 99 – Unknown if nodes are positive; not applicable, Not documented in patient record

11. Regional Nodes Examined

- a. 00 – No nodes examined
- b. 01-89 – 1-89 nodes examined (code exact number of regional lymph nodes examined)
- c. 90 – 90 or more nodes examined
- d. 95 – No regional nodes removed, but aspiration or core biopsy of regional nodes performed
- e. 96 – Regional lymph node removal documented as sampling and number of nodes unknown/not stated
- f. 97 – Regional lymph node removal documented as dissection and number of nodes unknown/not stated
- g. 98 – Regional lymph nodes surgically removed but number of lymph nodes unknown/not stated and not documented as sampling or dissection; nodes examined, but number unknown
- h. 99 – Unknown if nodes were examined; not applicable or negative, Not documented in patient record

12. SSF 1 – ER Assay

- a. 010 – Positive/elevated
- b. 020 – Negative/normal; within normal limits
- c. 030 – Borderline; undetermined whether positive or negative

- d. 988 – Not applicable: Information not collected for this case (if this item is required by your standard settler, use of code 988 will result in an edit error.)
- e. 996 – Test ordered, results not interpretable
- f. 997 – Test ordered, not in chart
- g. 998 – Test not done (test not ordered and not performed)
- h. 999 – Unknown or no information, Not documented in patient record

13. SSF 2 – PR Assay

- a. 010 – Positive/elevated
- b. 020 – Negative/normal; within normal limits
- c. 030 – Borderline; undetermined whether positive or negative
- d. 988 – Not applicable: Information not collected for this case (if this item is required by your standard settler, use of code 988 will result in an edit error.)
- e. 996 – Test ordered, results not interpretable
- f. 997 – Test ordered, not in chart
- g. 998 – Test not done (test not ordered and not performed)
- h. 999 – Unknown or no information, Not documented in patient record

14. SSF 14- HER2: Result of Other or Unknown Test

- a. 010 – Positive/elevated; amplified
- b. 020 – Negative/normal; within normal limits; not amplified
- c. 030 – Borderline; equivocal; indeterminate; undetermined whether positive or negative
- d. 988 – Not applicable: Information not collected for this case (if this item is required by your standard settler, use of code 988 will result in an edit error.)
- e. 997 – Test ordered, not in chart
- f. 998 – Test not done (test not ordered and not performed)
- g. 999 – Unknown or no information, Not documented in patient record

15. SSF 16 – Combination ER, PR & HER2

- a. 000 – ER Negative, PR Negative, HER2 Negative (Triple Negative)
- b. 001 – ER Negative, PR Negative, HER2 Positive
- c. 010 – ER Negative, PR Positive, HER2 Negative
- d. 011 – ER Negative, PR Positive, HER2 Positive
- e. 100 – ER Positive, PR Negative, HER2 Negative
- f. 101 – ER Positive, PR Negative, HER2 Positive
- g. 110 – ER Positive, PR Positive, HER2 Negative
- h. 111 – ER Positive, PR Positive, HER2 Positive
- i. 988 – Not applicable: Information not collected for this case (if this information is required by your standard settler, use of code 988 may result in an edit error.)
- j. 999 – One or more tests not performed, One or more tests unknown if performed, One or more test with unknown or borderline results, Unknown or no informatio

16. Overall Stage, T, N and M stage values

17. Surgery Date

18. Radiation therapy

- a. 1 = Received therapy
- b. 0 = Did not receive therapy

19. Chemo therapy

- a. 1 = Received therapy
- b. 0 = Did not receive therapy

20. Hormone therapy

- a. 1 = Received therapy
- b. 0 = Did not receive therapy

Appendix J – Information pamphlet for participants



istock photo

Are you eligible?

- Are you a female diagnosed with early stage breast cancer (Stage 1 or 2)
- Entering treatment for the first time (not recurrent cancer or entering followup treatment)
- Being treated for their breast cancer in Saskatchewan

Then you may be eligible!



Why is this study being done?

Breast cancer in North America is the most commonly diagnosed cancer and the second most common cause of cancer death in women.

For early stage breast cancer it is well established that breast conservation therapy and mastectomy offer equivalent survival.

However, Saskatchewan women have the second highest mastectomy rate in Canada

Between 2007 and 2010, 65% of all Saskatchewan patients with newly diagnosed breast cancer underwent mastectomy.

Contact us

If you want more information about the study, or wish to participate in this survey, please contact the study investigator:

Jeffrey Gu, MD

Phone: (306) 262-3537

Email: jeg998@mail.usask.ca

This study is funded by:



And has been approved by the University of Saskatchewan Research and Ethics Board ref # 123456789

To understand this difference researchers at the U of S and the Saskatchewan Cancer Agency are conducting a research survey to explore:

- What factors influence Saskatchewan women's choice of treatment for early stage breast cancer
- Identify potential gaps in provisions of care or delivery of information
- Identify avenues to improve delivery of care for patients with early stage breast cancer
- How Saskatchewan women's health treatment choices align with those in other provinces



Breast Cancer Therapy Decision Making Research Study

A Research Survey for Women with Early Stage Breast Cancer

What does participation include?

We are recruiting participants to take part in a survey

The survey will ask for details about:

- Your cancer diagnosis and treatment choices
- Your opinions and preferences regarding your treatment
- Your healthcare providers and relationships with them
- Your demographics

The survey can be filled in online or by telephone with the study investigator.

If you would like to participate please contact:

Jeffrey Gu

(306) 262-3537

jeg998@mail.usask.ca

Appendix K – Sample size outputs

Tumor Size Sample Size Calculation

Tests for Two Proportions

Numeric Results for Testing Two Proportions using the Z-Test with Unpooled Variance

H0: $O1/O2 = 1$ vs. H1: $O1/O2 = OR1 \neq 1$.

Target Power	Actual Power*	N1	N2	N	P1	P2	O.R. OR1	Alpha
0.80	0.80509	51	51	102	0.5878	0.3200	3.030	0.0500

1. Power was computed using the normal approximation method.

Surgeon Sex Sample Size Calculation

Tests for Two Proportions

Numeric Results for Testing Two Proportions using the Z-Test with Unpooled Variance

H0: $O1/O2 = 1$ vs. H1: $O1/O2 = OR1 \neq 1$.

Target Power	Actual Power*	N1	N2	N	P1	P2	O.R. OR1	Alpha
0.80	0.80884	39	39	78	0.7897	0.4970	3.800	0.0500

* Power was computed using the normal approximation method.

Travel Distance Sample Size Calculation

Tests for Two Proportions

Numeric Results for Testing Two Proportions using the Z-Test with Unpooled Variance

H0: $O1/O2 = 1$ vs. H1: $O1/O2 = OR1 \neq 1$.

Target Power	Actual Power*	N1	N2	N	P1	P2	O.R. OR1	Alpha
0.80	0.80255	46	46	92	0.2887	0.5670	0.310	0.0500

* Power was computed using the normal approximation method.

Peace of Mind Size Calculation

Tests for Two Proportions

Numeric Results for Testing Two Proportions using the Z-Test with Unpooled Variance

H0: $O1/O2 = 1$ vs. H1: $O1/O2 = OR1 \neq 1$.

Target Power	Actual Power*	N1	N2	N	P1	P2	O.R. OR1	Alpha
0.80	0.80006	160	160	320	0.5031	0.3500	1.880	0.0500
0.80	0.80103	157	157	314	0.5562	0.4000	1.880	0.0500
0.80	0.80051	157	157	314	0.6060	0.4500	1.880	0.0500

* Power was computed using the normal approximation method.

References

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Report Definitions

Target Power is the desired power value (or values) entered in the procedure. Power is the probability of rejecting a false null hypothesis.

Actual Power is the power obtained in this scenario. Because N1 and N2 are discrete, this value is often (slightly) larger than the target power.

N1 and N2 are the number of items sampled from each population.

N is the total sample size, $N1 + N2$.

P1 is the proportion for Group 1 at which power and sample size calculations are made. This is the treatment or experimental group.

P2 is the proportion for Group 2. This is the standard, reference, or control group.

OR1 is the odds ratio $[P1/(1-P1)] / [P2/(1-P2)]$ assumed for power and sample size calculations.

Alpha is the probability of rejecting a true null hypothesis.

Summary Statements

Group sample sizes of 171 in group 1 and 171 in group 2 achieve 80.207% power to detect an odds ratio of the group proportions of 1.880. The proportion in group 1 (the treatment group) is assumed to be 0.2900 under the null hypothesis and 0.4344 under the alternative hypothesis. The proportion in group 2 (the control group) is 0.2900. The test statistic used is the two-sided Z-Test with unpooled variance. The significance level of the test is 0.0500.

Appendix L – Invitation to participate letter



Dear Madam,

I am writing to invite you to participate in a research study that has been funded by the University of Saskatchewan. The goal of this study is to understand why Saskatchewan women choose mastectomy versus breast conserving therapy, thus we are looking for women who have been recently diagnosed and treated for early stage breast cancer to be a part of our study. We hope together the information we gain will provide surgeons, administrators, and patients with the knowledge they need to optimize and improve this process in the future.

We are looking for approximately 400 people like you to participate. Participation in this study is voluntary, and you can decide not to participate at any time by closing your browser, or choose not to answer any questions you don't feel comfortable with. If you decide not to participate or withdraw from the study, treatment and medical care will not be effected.

As with any online related activity, the risk of breach of confidentiality is possible. Strategies are in place to mitigate this risk including passcode secured storage and transfer of data. If you do not want to participate in this project or if you want to be removed from our mailing list, please contact Serena Kozie at the Saskatchewan Cancer Agency at (639) 625-2045 or by email at serena.kozie@saskcancer.ca. Completion of the survey should take 10-15 minutes.

Project Title: An Examination of Why Saskatchewan Women Choose Mastectomy Versus Breast Conservation Therapy in Early Stage Breast Cancer

Researcher: Jeffrey Gu (MD, PhD Candidate), Community Health & Epidemiology, University of Saskatchewan, jeg998@mail.usask.ca

Supervisor: Gary Groot (MD, FRCP, PhD) Community Health & Epidemiology, University of Saskatchewan, (306) 653-3366, garygroot@gmail.com

Rachel Engler-Stringer (PhD) Community Health & Epidemiology, University of Saskatchewan, (306) 966-7839, Rachel.engler-string@usask.ca

Participant Code – [insert 8 digit participation code]

This 8-digit participation code is required to gain access to the survey. Please enter this 8-digit participation code online to access the survey.

To participate:

1. Online link / url to the study: <http://tiny.cc/fq6sky>
2. Alternatively, if you do not have access to a computer we can administer the study via a phone-interview. **Please email or call Dr. Gu, jeg998@mail.usask.ca, (306)-262-3537 for more information and to volunteer to be a participant.**

Thank you for your time and participation in this study

Sincerely,

Jeffrey Gu, MD PhD Candidate
Department of General Surgery, Community Health and Epidemiology
University of Saskatchewan



Appendix M – Consent form oral telephone script

Consent Form Oral Telephone Script

“An Examination of Why Saskatchewan Women Choose Mastectomy Versus Breast Conservation Therapy in Early Stage Breast Cancer”

Assistant Researcher: Hello, my name is _____, and I am a research assisting helping with the study ‘an examination of why Saskatchewan women choose mastectomy versus breast conservation therapy in early stage breast cancer.’ Are you phoning to participate in this study?

Participant: Yes

[If participant states no → Conversation related to the study will end.]

[If participant wants more information related to the study → they will be directed to contact Jeffrey Gu or Gary Groot]

Assistant Researcher: Before commencing with the study, I would like to go over the consent to participate and make sure you understand everything. Can we do that now?

Participant: Yes

[If other response, refer to above responses]

Assistant Researcher:

Participation in this survey is voluntary, and you can decide not to participate at any time, or choose not to answer any questions you don’t feel comfortable with. After completion of the survey, certain pre-defined data items about your pathology and from your chart will be disclosed in a de-identified manner by the Saskatchewan Cancer Agency and linked to your survey results. Also know that you cannot be personally identified based on the data we collect. This research project has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

For more information on the study itself please contact by email or phone Dr. Jeffrey Gu (jeg998@mail.usask.ca, (306) 262-3537) or Dr. Gary Groot (garygroot@gmail.com, (306) 653-3366). For study results, please contact the researchers in January 2018. If you do not want to participate in this project or if you want to be removed from our mailing list, please contact Serena Kozie at the Saskatchewan Cancer Agency at (639) 625-2045 or by email at serena.kozie@saskcancer.ca

There are no known risks to participating in this survey; however, as with any online related activity the risk of breach of confidentiality is possible. If you decide not to participate or withdraw from the study, your treatment and medical care will not be affected. Survey responses will remain anonymous. Since the survey is anonymous, once it's submitted it cannot be removed.

This survey is hosted by Voxco, a Canadian-owned and managed company whose data is securely stored in Canada.

This survey will take approximately 10-15 minutes. If you would like a copy of this consent form for your own records, we can mail it to you.

Do you understand and give consent to participate in this study?

Participant: Yes [Continue onto survey]

[If participant states no → Conversation related to the study will end.]

[If participant wants more information related to the study → they will be directed to contact Jeffrey Gu or Gary Groot]

Appendix N – Additional Methods and Results from Survey Not Included in Manuscript #4

Methods

Correlational mapping was performed for individual belief factors asked of both BCT and mastectomy participants using R Studio.

There exists a debate for how to statistically treat Likert scales, categorical versus ordinal. We have performed a sensitivity analysis for the individual belief factors items which utilized a 5 point Likert scale (Table N1). Logistic regression was performed treating these items as ordinal, categorical with 3 categories, and categorical with 2 categories (Table 8.3). The 3 categories include combined strongly disagree and disagree, neither agree nor disagree, and combined agree and strongly agree (Table N2). The 2 categories include combining strongly disagree, disagree, and neither agree nor disagree and combined agree and strongly agree (Table N3).

Table N1: Sensitivity Analysis for Significance of Personal Belief Factors – Ordinal versus 3 Group Categorical versus 2 Group Categorical

	Ordinal (1, 2, 3, 4, 5)	Categorical (1+2, 3, 4+5)	Categorical (1+2+3, 4+5)
Worry About Cancer Recurrence	Significant	Significant	Significant
Age	Not Significant	Significant	Significant
Other Individual Medical History	Not Significant	Not Significant	Not Significant
Family History of Breast Cancer	Significant	Significant	Significant
Previous Breast Disease	Not Significant	Not Significant	Not Significant
Breast Size	Not Significant	Not Significant	Not Significant
Tumor Size	Significant	Significant	Significant
Travel Distance	Not Significant	Not Significant	Significant
Surgeon's Opinion	Significant	Significant	Significant
Feminine Identity	Significant	Significant	Significant
Sexuality	Significant	Significant	Significant
Wanting to Keep Breast Tissue	Significant	Significant	Significant

Incorporating Reconstruction	Not Significant	Significant	Significant
Total Treatment Time	Significant	Significant	Significant

1 = Strongly Disagree

2 = Disagree

3 = Neither Agree nor disagree

4 = Agree

5 = Strongly Agree

Table N2: Personal Belief and Preference Factors for Mastectomy versus BCT Participants – 3 Group Categorical Logistic Regression

	Odds Ratio	95% C.I.	p-value
Worry About Cancer Recurrence			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	1.51	0.65 – 3.49	0.33
Agree and strongly agree	14.7	7.28 – 29.80	<0.01
Age			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.65	0.32 – 1.32	0.24
Agree and strongly agree	1.94	1.14 – 3.29	<0.01
Other Individual Medical History			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.82	0.44 – 1.54	0.54
Agree and strongly agree	1.56	0.89 – 2.73	0.12
Family History of Breast Cancer			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.84	0.48 – 1.49	0.556
Agree and strongly agree	2.22	1.21 – 4.08	<0.01
Previous Breast Disease			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	1.00	0.58 – 1.72	0.99
Agree and strongly agree	1.66	0.85 – 3.22	0.14
Breast Size			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.77	0.42 – 1.44	0.42
Agree and strongly agree	1.28	0.65 – 2.52	0.48
Tumor Size			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.92	0.35 – 2.39	0.86
Agree and strongly agree	0.25	0.14 – 0.44	<0.01
Travel Distance			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	1.20	0.60 – 2.39	0.60
Agree and strongly agree	2.63	1.00 – 6.92	0.05
Surgeon's Opinion			

Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.55	0.24 – 1.27	0.16
Agree and strongly agree	0.28	0.15 – 0.52	<0.01
Feminine Identity			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	1.21	0.61 – 2.38	0.59
Agree and strongly agree	0.25	0.13 – 0.47	<0.01
Sexuality			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.78	0.40 – 1.48	0.44
Agree and strongly agree	0.19	0.08 – 0.43	<0.01
Wanting to Keep Breast Tissue			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.34	0.18 – 0.66	0.01
Agree and strongly agree	0.03	0.01 – 0.08	<0.01
Incorporating Reconstruction			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	0.68	0.38 – 1.23	0.20
Agree and strongly agree	1.97	1.05 – 3.71	<0.01
Total Treatment Time			
Strongly disagree and disagree	1.00	Referent	
Neither agree nor disagree	1.18	0.64 – 2.17	0.59
Agree and strongly agree	2.35	1.23 – 4.49	<0.01

Note: denominators may vary depending on response rate for each questionnaire item.

Univariate logistic regression was used to evaluate likelihood of mastectomy versus BCT. Higher odds favours mastectomy.

p-values listed used significance level of 0.05.

Table N3: Personal Belief and Preference Factors for Mastectomy versus BCT Participants – 2 Group Categorical Logistic Regression

	Odds Ratio	95% C.I.	p-value
Worry About Cancer Recurrence			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	12.16	6.87 – 21.5	<0.01
Age			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	2.18	1.33 – 3.57	<0.01
Other Individual Medical History			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	1.65	0.97 – 2.80	0.07
Family History of Breast Cancer			

Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	2.37	1.35 – 4.17	<0.01
Previous Breast Disease			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	1.66	0.88 – 3.12	0.12
Breast Size			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	1.35	0.70 – 2.63	0.37
Tumor Size			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	0.25	0.15 – 0.42	<0.01
Travel Distance			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	2.56	0.97 – 6.70	0.06
Surgeon's Opinion			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	0.35	0.21 – 0.58	<0.01
Feminine Identity			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	0.24	0.12 – 0.45	<0.01
Sexuality			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	0.20	0.09 – 0.45	<0.01
Wanting to Keep Breast Tissue			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	0.04	0.16 – 0.11	<0.01
Incorporating Reconstruction			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	2.22	1.21 – 4.06	0.01
Total Treatment Time			
Strongly disagree, disagree, and neither agree nor disagree	1.00	Referent	
Agree and strongly agree	2.25	1.20 – 4.22	0.01

Note: denominators may vary depending on response rate for each questionnaire item.
Univariate logistic regression was used to evaluate likelihood of mastectomy versus BCT. Higher odds favours mastectomy.
p-values listed used significance level of 0.05.

Clinically important effect modifiers were individually tested for potential inclusion in the model using an interaction term. These were informed by research team and clinical consultation with local experts in the field. The following interaction terms were tested for potential inclusion into the model:

- 'Wanting to keep my own breast tissue' by age
- 'Incorporating reconstruction' by age
- 'Fear of cancer recurrence' by 'family history of breast cancer'
- 'Surgeon's influence' by age
- 'Surgeon's influence' by subjective 'tumor size'
- 'Feminine identity' by wanting to keep my own breast issue'
- Stage of disease by 'income'
- Stage of disease by 'surgeon's opinion'
- Stage of disease by subjective 'tumor size'

Two interaction terms, stage of disease by 'surgeon's opinion' and stage of disease by subjective 'tumor size', were statistically significant with p-value <0.05 (Chapter 8). All other interaction terms were non-significant.

Results

Personal Belief and Preference Factors

We asked participants to rate how much each individual preference factor influenced their choice of therapy on a 5-point Likert scale. Of the 14 questions asked of both groups (Table N4, Figure 8.2), only other medical history, previous breast disease, and breast size were not significantly different between groups. The belief factors that were rated as significantly ($p < 0.05$) more important for mastectomy patients were worry about cancer recurrence, age, family history of breast cancer, travel distance, incorporating reconstruction, and total treatment time. The factors that were rated as significantly

($p < 0.05$) more important for BCT patients were tumor size, surgeon opinion, feminine identity, sexuality, and keeping one's own breast tissue.

Five other questions were specific for mastectomy participants only (Table N5). Of these factors, 'avoiding the potential for requiring further surgery' had 71% of mastectomy participants rating agree or strongly agree to influencing their therapy choice (Figure 8.3). Two other questions were specific for BCT participants only (Table N6). Of these factors, 'feeling that mastectomy was too radical or extreme of a procedure' had 51% of BCT participants rating agree or strongly agree to influencing their therapy choice (Figure 8.4).

Correlational maps for mastectomy individual belief factors are presented in Figure N1 and Table N4. The correlational coefficient for 'worry about cancer recurrence' and 'family history of breast cancer' was 0.34. The correlational coefficient for 'tumor size' and 'surgeon's opinion' was 0.33. Correlational maps for BCT individual belief factors are presented in Figure N2 and Table N5. The correlation coefficient for responses between 'feminine identity' with 'my sexuality' and 'wanting to keep my own breast tissue' was 0.68 and 0.65 respectively. The correlation between the factors 'my sexuality' and 'wanting to keep my own breast tissue' was also high at 0.51, suggesting a strong relationship between these three factors for women choosing BCT.

Table N4: Personal Belief and Preference Factors for Mastectomy versus BCT Participants

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	p-value
Worry About Cancer Recurrence						<0.01
Mastectomy n (%)	6 (4.0)	8 (5.3)	15 (10.0)	53 (35.6)	67 (45.0)	
BCT n (%)	14 (7.3)	41 (17.8)	39 (19.6)	21 (26.9)	11 (28.4)	
Age						<0.01
Mastectomy n (%)	26 (17.5)	31 (20.8)	17 (11.4)	57 (38.3)	18 (12.1)	

BCT n (%)	16 (12.7)	43 (34.1)	27 (21.4)	33 (26.2)	7 (5.6)	
Other Individual Medical History						0.28
Mastectomy n (%)	26 (17.3)	47 (31.3)	26 (17.3)	29 (19.3)	22 (14.7)	
BCT n (%)	20 (15.9)	47 (37.3)	29 (23.0)	20 (15.9)	10 (7.9)	
Family History of Breast Cancer						<0.01
Mastectomy n (%)	23 (17.4)	38 (28.8)	19 (14.4)	19 (14.4)	33 (25.0)	
BCT n (%)	23 (20.6)	37 (33.0)	29 (19.7)	19 (15.6)	4 (15.2)	
Previous Breast Disease						0.18
Mastectomy n (%)	28 (18.9)	45 (30.4)	43 (29.1)	18 (12.2)	14 (9.5)	
BCT n (%)	23 (18.3)	45 (35.7)	40 (31.8)	15 (11.9)	3 (2.4)	
Breast Size						0.32
Mastectomy n (%)	48 (32.2)	50 (33.6)	25 (16.8)	17 (11.4)	9 (6.0)	
BCT n (%)	32 (25.4)	50 (39.7)	27 (21.4)	14 (11.1)	3 (2.4)	
Tumor Size						<0.01
Mastectomy n (%)	22 (14.8)	38 (25.5)	21 (14.1)	44 (29.5)	24 (16.1)	
BCT n (%)	7 (5.6)	14 (11.1)	8 (6.4)	61 (48.4)	36 (28.6)	
Travel Distance						<0.01
Mastectomy n (%)	68 (45.3)	43 (28.7)	22 (14.7)	11 (7.3)	6 (4.0)	
BCT n (%)	44 (34.9)	59 (46.8)	17 (13.5)	6 (4.7)	0 (0)	
Surgeon's Opinion						<0.01
Mastectomy n (%)	22 (14.9)	31 (21.0)	23 (15.5)	41 (27.7)	31 (21.0)	
BCT n (%)	10 (7.9)	9 (7.1)	15 (11.9)	39 (31.0)	53 (42.1)	
Feminine Identity						<0.01
Mastectomy n (%)	45 (30.0)	59 (39.3)	30 (20.0)	13 (8.7)	3 (2.0)	
BCT n (%)	21 (16.8)	46 (36.8)	16 (12.8)	28 (22.4)	14 (11.2)	
Sexuality						<0.01
Mastectomy n (%)	49 (32.7)	68 (45.3)	25 (16.7)	7 (4.7)	1 (0.7)	
BCT n (%)	30 (28.7)	46 (41.5)	21 (16.7)	22 (10.6)	6 (2.6)	
Wanting to Keep Breast Tissue						<0.01
Mastectomy n (%)	47 (31.3)	74 (49.3)	24 (16.0)	4 (2.7)	1 (0.7)	
BCT n (%)	10 (20.7)	33 (38.3)	25 (17.8)	36 (14.5)	22 (8.3)	
Incorporating Reconstruction						0.04
Mastectomy n (%)	30 (20.0)	48 (32.0)	29 (19.3)	32 (21.3)	11 (7.3)	
BCT n (%)	21 (16.9)	47 (37.9)	37 (29.8)	12 (9.7)	7 (5.7)	
Total Treatment Time						0.01
Mastectomy n (%)	33 (22.0)	48 (32.0)	30 (20.0)	26 (17.3)	13 (8.7)	

BCT n (%)	22 (17.5)	61 (48.4)	26 (20.6)	15 (11.9)	2 (1.6)	
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Note: denominators may vary depending on response rate.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

p-values listed used significance level of 0.05.

Table N5: Personal Belief and Preference Factors for Mastectomy Participants Only

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Avoid Further Surgery Potential					
Mastectomy n (%)	11 (7.4)	22 (14.7)	10 (6.7)	56 (37.6)	50 (33.6)
Length of Radiation Therapy					
Mastectomy n (%)	32 (21.3)	50 (33.3)	34 (22.7)	15 (10.0)	19 (12.7)
Avoiding Radiation Therapy					
Mastectomy n (%)	24 (16.0)	44 (29.3)	27 (18.0)	27 (18.0)	28 (18.7)
Lodging For Radiation Therapy					
Mastectomy n (%)	58 (38.9)	54 (36.2)	21 (14.1)	11 (7.4)	5 (3.4)
Wanting Prophylactic Mastectomy					
Mastectomy n (%)	22 (14.9)	34 (23.0)	42 (28.4)	29 (19.6)	21 (14.1)

Note: denominators may vary depending on response rate.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

p-values listed used significance level of 0.05.

Table N6: Personal Belief and Preference Factors for BCT Participants Only

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Recovery Time For Mastectomy					
BCT n (%)	20 (16.1)	54 (43.6)	27 (21.8)	15 (12.1)	8 (6.5)
Feeling Mastectomy Too Radical / Extreme					
BCT n (%)	13 (10.3)	28 (22.2)	21 (16.7)	37 (29.4)	27 (21.4)

Note: denominators may vary depending on response rate.

Comparison between mastectomy and BCT were made using Pearson's chi-square test unless otherwise specified.

p-values listed used significance level of 0.05.

Figure N1: Correlation Heat Mapping of Mastectomy Responses for Individual Belief Factors

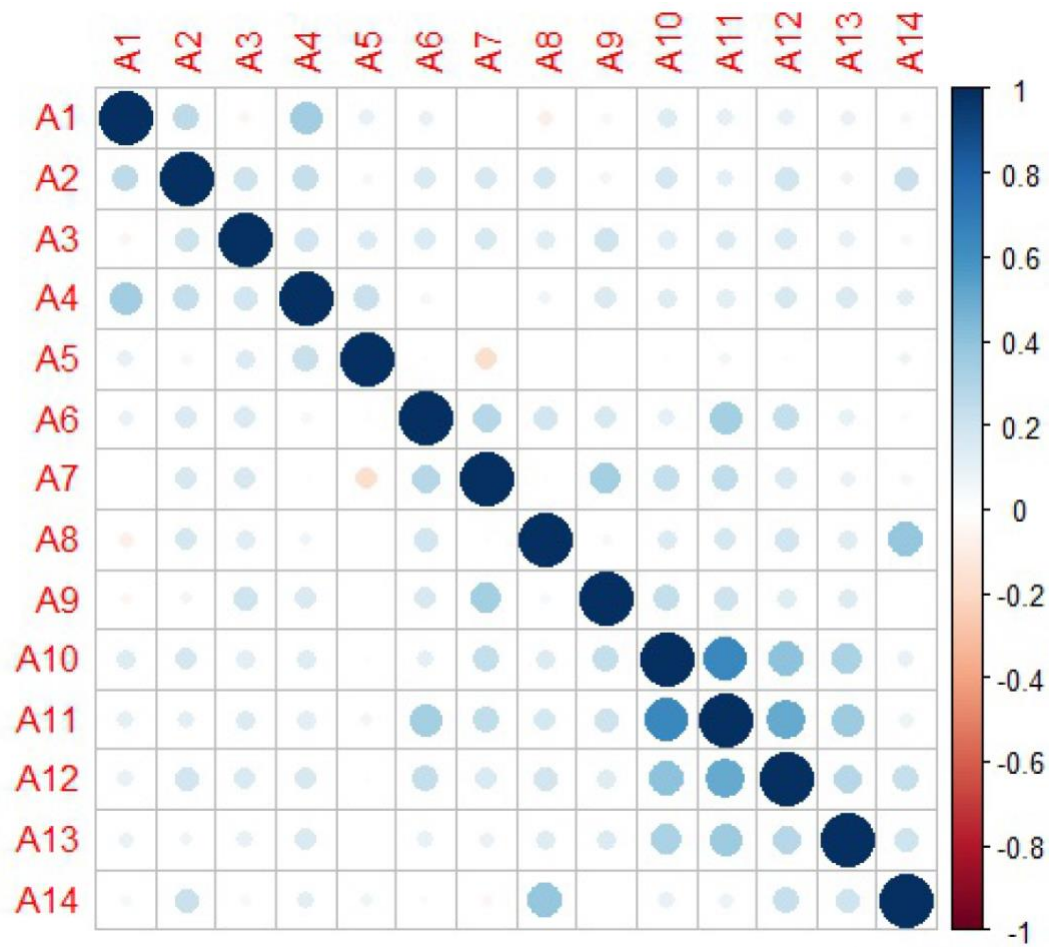


Figure N2: Correlation Heat Mapping of BCT Responses for Individual Belief Factors

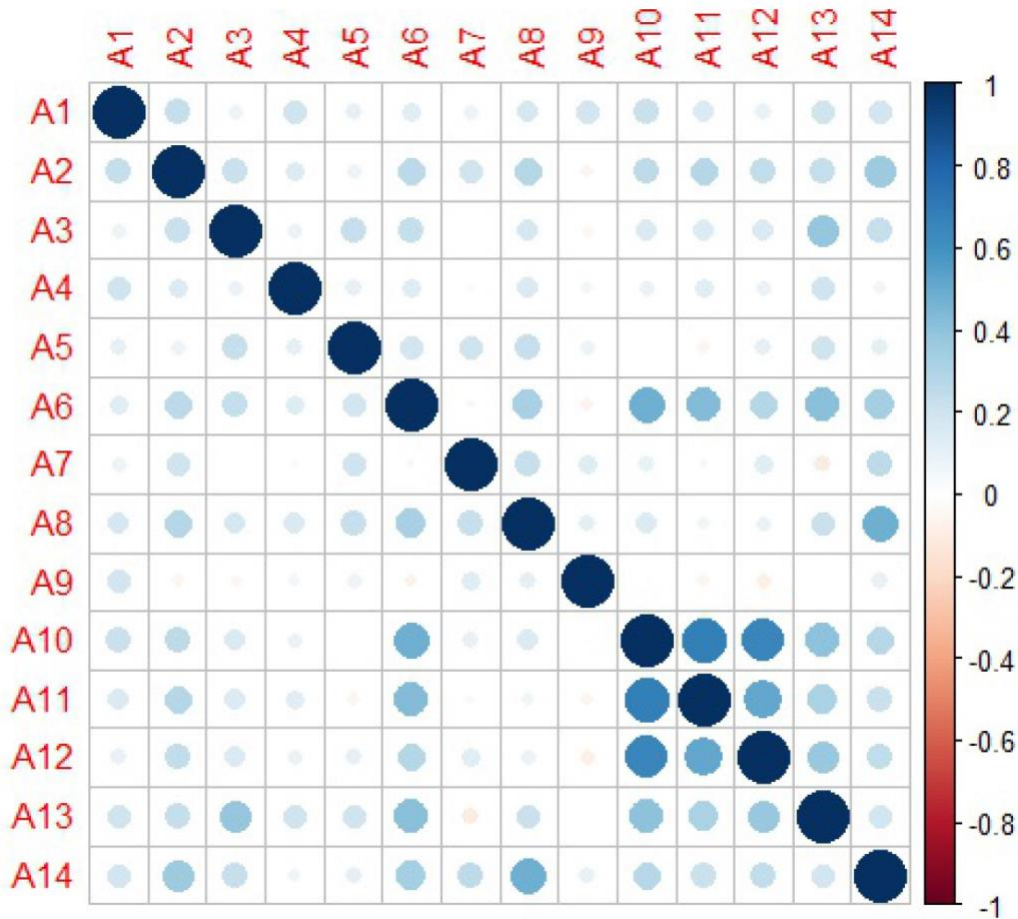


Table N4: Correlation Coefficients of Mastectomy Responses for Individual Belief Factors

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
A1	1.00000000	0.25116640	-0.04912991	0.34246131	0.09579656	0.08702747	-0.008510419	-0.072559806	-0.034707598	0.13235768	0.10543388	0.09912281	0.084916932	0.046288557
A2	0.25116640	1.00000000	0.20905532	0.23408813	0.041812817	0.15541171	0.167469721	0.174469230	0.053042321	0.17167549	0.11108406	0.18616884	0.063072524	0.213117001
A3	-0.049129907	0.20905532	1.00000000	0.18487225	0.145384352	0.14899691	0.166382076	0.126891844	0.198888029	0.11916128	0.14323289	0.15107727	0.094324850	0.036249619
A4	0.342461305	0.23408813	0.18487225	1.00000000	0.218690573	0.04748339	-0.011654874	0.062364413	0.159240205	0.13735425	0.11873634	0.16028451	0.152594910	0.115200021
A5	0.095796560	0.04181282	0.14538435	0.21869057	1.00000000	0.01564576	-0.161180440	0.009760844	0.007874213	0.01685158	0.05430322	0.01131458	-0.005283262	0.062440805
A6	0.087027465	0.15541171	0.14899691	0.04748339	0.01564577	1.00000000	0.273115834	0.186543226	0.165468417	0.10117819	0.33993896	0.23610510	0.098395090	0.023087107
A7	-0.008510419	0.16746972	0.16638208	-0.01165487	-0.161180440	0.27311583	1.00000000	-0.012489389	0.334652901	0.23225136	0.24031948	0.15713210	0.083082680	-0.048073697
A8	-0.072559806	0.17446923	0.12689184	0.06236441	0.009760844	0.18654323	-0.012489389	1.00000000	0.038022211	0.14115507	0.17608384	0.18628167	0.130569308	0.388501959
A9	-0.034707598	0.05304232	0.19888803	0.15924021	0.007874213	0.16546842	0.334652901	0.038022211	1.00000000	0.23529619	0.20091521	0.13433534	0.142032806	0.009705087
A10	0.132357675	0.17167549	0.11916128	0.13735425	0.016851588	0.10117819	0.232251360	0.141155073	0.235296190	1.00000000	0.64918503	0.40334639	0.311032532	0.094144965
A11	0.105433883	0.11108406	0.14323289	0.11873634	0.054303221	0.33993896	0.240319475	0.176083844	0.200915213	0.64918503	1.00000000	0.50701790	0.350639987	0.075994105
A12	0.099122806	0.18616884	0.15107727	0.16028451	0.011314578	0.23610510	0.157132102	0.186281667	0.134335337	0.40334639	0.50701790	1.00000000	0.273933075	0.220827489
A13	0.084916932	0.06307252	0.09432485	0.15259491	-0.005283262	0.09839509	0.083082680	0.130569308	0.142032806	0.31103253	0.35063999	0.27393308	1.00000000	0.198807443
A14	0.046288557	0.21311700	0.03624962	0.11520002	0.062440805	0.02308711	-0.048073697	0.388501959	0.009705087	0.09414496	0.07599410	0.22082749	0.198807443	1.000000000

Table N5: Correlation Coefficients of BCT Responses for Individual Belief Factors

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
A1	1.00000000	0.23777542	0.074028923	0.19016788	0.10287653	0.12217955	0.076237736	0.17584816	0.18478364	0.21436536	0.15584797	0.09967153	0.199422662	0.18552988
A2	0.23777542	1.00000000	0.214728826	0.14191441	0.07341231	0.26681074	0.190690567	0.28097442	-0.052950113	0.25197644	0.28327231	0.24385066	0.231983740	0.35901398
A3	0.07402892	0.21472883	1.00000000	0.08246114	0.22068595	0.23458577	0.005860223	0.17449593	-0.042898208	0.15305335	-0.14914970	0.15299518	0.382611029	0.22775043
A4	0.19016788	0.14191441	0.08246114	1.00000000	0.10044592	0.13380268	-0.023559213	0.15330729	0.055228696	0.08128363	0.12407203	0.08962986	0.197026949	0.06726343
A5	0.10287653	0.07341231	0.22068595	0.10044592	1.00000000	0.18375080	0.199287137	0.22817308	0.075184878	0.00000000	-0.05178635	0.10064635	0.194886206	0.11032814
A6	0.12217955	0.26681074	0.23458577	0.13380268	0.18375080	1.00000000	0.03193474	0.32394487	-0.066415808	0.48163881	0.43524184	0.28501941	0.414058194	0.33715458
A7	0.07623774	0.19069057	0.005860223	-0.02355921	0.19928714	0.03193474	1.00000000	0.22831552	0.130057998	0.09637442	0.03047907	0.12954564	-0.106273089	0.25008710
A8	0.17584816	0.28097442	0.174495927	0.1330729	0.22817308	0.32394487	0.228315524	1.00000000	0.110687510	0.14912483	0.06202061	0.08370418	0.210672238	0.48172506
A9	0.18478364	0.05295011	-0.042898208	0.05522870	0.07518488	-0.06641581	0.130057998	0.11068751	1.00000000	0.01262007	-0.05436304	-0.08266348	0.005639645	0.09682611
A10	0.21436536	0.25197644	0.153053349	0.08128363	0.00000000	0.48163881	0.096374419	0.14912483	0.012620071	1.00000000	0.68485218	0.65379307	0.40999563	0.27574702
A11	0.15584797	0.28327231	0.149149699	0.12407203	-0.05178635	0.43524184	0.030479072	0.06202061	-0.054363039	0.68485218	1.00000000	0.51348171	0.314812995	0.21937492
A12	0.09967153	0.24385066	0.152995177	0.08962986	0.10064635	0.28501941	0.129545637	0.08370418	-0.082663482	0.65379307	0.51348171	1.00000000	0.370919791	0.24481450
A13	0.19942266	0.23198374	0.382611029	0.19702695	0.19488621	0.41405819	-0.106273089	0.21067224	0.005639645	0.4099956	0.31481299	0.37091979	1.000000000	0.18818529
A14	0.18552988	0.35901398	0.227750432	0.06726343	0.11032814	0.33715458	0.250087099	0.48172506	0.096826111	0.27574702	0.21937492	0.24481450	0.188185287	1.000000000

Physician Factors

Participants were also asked if the alternative treatment option was discussed with them (Table N7). There was no significant difference in self-reported discussion between

mastectomy and BCT groups, 67% and 71% respectively. However, when separated by treatment type and city of surgery, women undergoing mastectomy in Regina were less likely to have self-reported discussion of BCT as a possible treatment option, 52% compared with 75% in Saskatoon and 91% in smaller surgical centers.

Table N7: Discussion of other treatment options and distribution by city

	Yes n (%)	No n (%)	Do Not Remember n (%)	p-value
Discussion of Other Treatment Option				0.31
Mastectomy (n = 150)	100 (66.7)	39 (26.0)	11 (7.33)	
BCT (n = 126)	89 (70.6)	33 (26.2)	4 (3.2)	
City of Surgery (Mastectomy)				<0.01
Saskatoon (n = 79)	59 (74.7)	15 (19.0)	5 (6.3)	
Regina (n = 60)	31 (51.7)	24 (40.0)	5 (8.3)	
Other (n = 11)	10 (90.9)	0 (0.0)	1 (9.1)	
City of Surgery (BCT)				0.26
Saskatoon (n = 79)	47 (75.8)	13 (21.0)	2 (3.2)	
Regina (n = 79)	35 (71.4)	13 (26.5)	1 (2.0)	
Other (n = 79)	7 (46.7)	7 (46.7)	1 (6.7)	

Comparison between mastectomy and BCT were made using Pearson's chi-square test.
p-values listed used significance level of 0.05.